

# **Quality Assurance Project Plan**

## **Site 7 – RTC Silk Screen Shop and Site 17 – Pettibone Creek & Boat Basin**

### **Remedial Investigation & Risk Assessment**

#### **Volume I of II**

**Text and Appendices I, II, III, V, VI, VII, VIII, and IX**

**Naval Training Center Great Lakes  
Great Lakes, Illinois**



**Southern Division  
Naval Facilities Engineering Command**

**Contract Number N62467-94-D-0888**

**Contract Task Order 0154/0290**

July 2001  
Revised July 2002  
Revised June 2003

**TETRA TECH NUS, INC.**

661 Andersen Drive • Pittsburgh, PA 15220  
Tel 412.921.7090 • Fax 412.921.4040 • www.tetrattech.com

PITT-06-3-060

June 27, 2003

Project 1474

Commander, Southern Division  
Naval Facilities Engineering Command  
Attn: Mr. Anthony Robinson (ES 31)  
2155 Eagle Drive  
North Charleston, South Carolina 29406

Reference: CLEAN Contract No. N62467-94-D-0888  
Contract Task Order 0290

Subject: Final Revisions to the Existing Quality Assurance Project Plan (QAPP) and the  
QAPP for Site 22 and Response to Illinois EPA Comments  
Site 22 – Building 105 Old Dry Cleaning Facility  
Naval Training Center Great Lakes  
Great Lakes, Illinois

Dear Mr. Robinson:

Please find attached three copies of subject report. Copies have also been distributed as indicated below. The revisions to the existing QAPP are explained in the table below. The signed title page will be submitted when all signatures have been received. If you have any questions, please call Aaron Bernhardt at 412-921-8433 or me at 412-921-7251.

Page	Description of Change
Cover page	Added "VIII and IX", "Revised July 2002" and "Revised April 2003 (Draft)"
Table of Contents p 1 of 4	Added Preface
Table of Contents p 3 of 4	Added Appendices VIII and IX to the list of Appendices and revised the title to Table A-1
Table of Contents p 4 of 4	Revised the title to Tables A-6 to A-11
Table A-1	Replaced the name of Brian Holtrop with Dan Fleming and corrected several telephone numbers/extensions
Figure A-1	Replaced the name of Brian Holtrop with Dan Fleming
Figure A-2	Added Site 22
Figures A-6 to A-11	Revised the title from "Site 7" to "Site 7 and 22"

Sincerely,

Robert F. Davis, P.E.  
Task Order Manager

RFD/kf

Enclosure



Mr. Anthony Robinson  
Naval Facilities Engineering Command  
June 27, 2003 – Page 2

cc: O. Thompson, EPA Region 5 (2 copies)  
D. Fleming/M. Schultz, NTC Great Lakes (2 copies)  
B. Conrath, IEPA (4 copies)  
D. Wroblewski, TtNUS (Cover Letter Only)  
Mark Perry/File 1474, TtNUS (1 copy)  
A. Bernhardt, TtNUS (letter only)  
File CTO 154/3939 (letter only)

**QUALITY ASSURANCE PROJECT PLAN  
SITE 7 – RTC SILK SCREEN SHOP  
AND  
SITE 17 – PETTIBONE CREEK & BOAT BASIN  
REMEDIAL INVESTIGATION & RISK ASSESSMENT  
  
NAVAL TRAINING CENTER GREAT LAKES  
GREAT LAKES, ILLINOIS  
  
COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

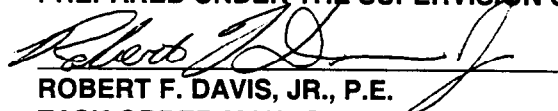
**Submitted to:  
Southern Division  
Naval Facilities Engineering Command  
2155 Eagle Drive  
North Charleston, South Carolina 29406**

**Submitted by:  
Tetra Tech NUS, Inc.  
661 Andersen Drive  
Foster Plaza 7  
Pittsburgh, Pennsylvania 15220**

**CONTRACT NUMBER N62467-94-D-0888  
CONTRACT TASK ORDER 0154**

**JULY 2001**

**PREPARED UNDER THE SUPERVISION OF:**



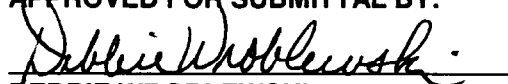
**ROBERT F. DAVIS, JR., P.E.  
TASK ORDER MANAGER  
TETRA TECH NUS, INC.**

**ANTHONY ROBINSON  
REMEDIAL PROJECT MANAGER  
NAVAL FACILITIES ENGINEERING COMMAND**

**OWEN THOMPSON  
PROJECT MANAGER  
U.S. EPA REGION 5**

**MARK SCHULTZ  
ENVIRONMENTAL SITE MANAGER  
NAVAL TRAINING CENTER GREAT LAKES**

**APPROVED FOR SUBMITTAL BY:**



**DEBBIE WROBLEWSKI  
PROGRAM MANAGER  
TETRA TECH NUS, INC.**



**PAUL V. FRANK  
QUALITY ASSURANCE MANAGER  
TETRA TECH NUS, INC.**

**BRIAN A. CONRATH  
PROJECT MANAGER  
ILLINOIS EPA**

**LESLIE MORROW  
RISK ASSESSOR  
ILLINOIS EPA**

## **PREFACE**

The original Quality Assurance Project Plan (QAPP) for Site 7 – Silk Screen Shop and Site 17 – Pettibone Creek & Boat Basin has been prepared by Tetra Tech NUS (TtNUS), on behalf of the United States (U.S.) Navy Southern Division Naval Facilities Engineering Command and Naval Training Center (NTC) Great Lakes, Great Lakes, Illinois under the Comprehensive Long-term Environmental Action Navy (CLEAN) III Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0154. The following revisions/changes/additions to the QAPP have occurred

- Revised July 2002 – Added Appendix VIII, an addendum to the existing Health and Safety Plan for the hot spot removal activities at Site 7.
- Revised April 2003 (Draft) – Revised the project personnel table and figure and added Appendix IX for the investigation at Site 22 – Building 105 Old Dry Cleaner Facility. This investigation will be similar to the investigation at Site 7. Appendix IX is intended to be used in conjunction with the existing QAPP, Field Sampling Plan, and Health and Safety Plan.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE NO.</u>
<b>PREFACE .....</b>	<b>iii</b>
<b>ACRONYMS .....</b>	<b>1</b>
<b>A. PROJECT MANAGEMENT .....</b>	<b>A-1</b>
A1 TITLE PAGE AND APPROVAL SHEET .....	A-1
A2 TABLE OF CONTENTS AND DOCUMENT CONTROL.....	A-1
A3 DISTRIBUTION LIST .....	A-1
A4 PROJECT/TASK ORGANIZATION .....	A-1
A4.A Management Responsibilities .....	A-1
A4.B Quality Assurance Responsibilities .....	A-4
A4.C Field Responsibilities .....	A-5
A4.D Laboratory Responsibilities .....	A-8
A4.E Special Training Requirements and Certifications .....	A-10
A5 PROBLEM DEFINITION/BACKGROUND INFORMATION .....	A-10
A5.A Background Information .....	A-11
A5.B Project Problem Statement .....	A-22
A6 PROJECT/TASK DESCRIPTION .....	A-23
A6.A Project Planning .....	A-23
A6.B Schedule .....	A-26
A7 DQO/PARCC SUMMARY .....	A-26
A7.A Precision Assessment.....	A-27
A7.B Accuracy Assessment.....	A-29
A7.C Representativeness Assessment.....	A-30
A7.D Completeness Assessment.....	A-31
A7.E Comparability Assessment.....	A-32
A7.F Sensitivity .....	A-33
A8 SPECIAL TRAINING REQUIREMENTS / CERTIFICATION.....	A-33
A9 DOCUMENTATION AND RECORDS.....	A-33
A9.A Log Books and Forms .....	A-33
A9.B Data reporting package format and documentation control.....	A-35
<b>B. DATA GENERATION AND ACQUISITION.....</b>	<b>B-1</b>
B1 SAMPLING PROCESS DESIGN .....	B-1
B1.A Site 7 .....	B-1
B1.B Site 17 .....	B-1
B2 SAMPLING METHODS REQUIREMENTS .....	B-2
B2.A Sampling Standard Operating Procedures (SOPs) .....	B-2
B2.B Cleaning and Decontamination of Equipment/Sample Containers.....	B-15
B2.C Field Equipment Maintenance .....	B-15
B2.D Inspection and Acceptance Requirements for Supplies/Sample Containers .....	B-16
B3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS .....	B-16
B3.A Sampling Handling .....	B-16
B3.B Sample Custody .....	B-18
B4 ANALYTICAL METHODS REQUIREMENTS .....	B-22
B5 QUALITY CONTROL (QC) REQUIREMENTS .....	B-23

## TABLE OF CONTENTS (Continued)

<u>SECTION</u>	<u>PAGE NO.</u>
B5.A Field Sampling QC.....	B-23
B5.B Analytical QC Checks.....	B-24
B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS.....	B-28
B6.A Field Instrument Maintenance .....	B-28
B6.B Laboratory Instrument Maintenance.....	B-28
B7 INSTRUMENTATION CALIBRATION AND FREQUENCY.....	B-28
B8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES .....	B-30
B9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS).....	B-31
B10 DATA MANAGEMENT .....	B-32
B10.A Data Recording.....	B-32
B10.B Data Validation .....	B-32
B10.C Data Transformation/Data Reduction .....	B-33
B10.D Data Transmittal/Transfer.....	B-34
B10.E Data Analysis.....	B-34
B10.F Data Assessment.....	B-35
B10.G Data Tracking .....	B-35
B10.H Data Storage and Retrieval .....	B-35
B10.I Data Security .....	B-36
 C. ASSESSMENT/OVERSIGHT.....	 C-1
C1 ASSESSMENT AND RESPONSE ACTIONS .....	C-1
C1.A Field and Laboratory Planned Assessments .....	C-1
C2 REPORTS TO MANAGEMENT .....	C-4
 D. DATA VERIFICATION/VALIDATION AND USABILITY .....	 D-1
D1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS .....	D-1
D1.A Sampling Design.....	D-1
D1.B Sample Collection Procedures .....	D-1
D1.C Sample Handling .....	D-1
D1.D Analytical Procedures .....	D-2
D1.E Quality Control .....	D-2
D1.F Calibration.....	D-2
D1.G Data Reduction and Processing.....	D-3
D2 VALIDATION AND VERIFICATION METHODS .....	D-3
D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES .....	D-4
 REFERENCES .....	 R-1

## TABLE OF CONTENTS (Continued)

### APPENDICES

I	Human Health Risk Assessment Work Plan
II	Ecological Risk Assessment Work Plan
III	Data Quality Objectives
IV	Laboratory Standard Operating Procedures
V	Supplemental Field Sampling Plan and Field Standard Operating Procedures
VI	Data Management Plan
VII	Health and Safety Plan
VIII	Health and Safety Plan Additions (Hot Spot Removal)
IX	QAPP/Supplemental FSP/HASP Site 22, Building 105 Old Dry Cleaning Facility

### TABLES

<u>NUMBER</u>	<u>PAGE NO.</u>
A-1	Project Personnel Names, Phone Numbers, and Addresses.....A-37
A-2	Frequency of Detection - Site 7 .....A-39
A-3	Offsite Sediment Frequency of Detection – Site 17 .....A-41
A-4	Offsite Surface Water Frequency of Detection – Site 17 .....A-44
A-5	Pettibone Creek Sediment Frequency of Detection – Site 17 .....A-45
A-6	Pettibone Creek Surface Water Frequency of Detection – Site 17 .....A-47
A-7	South Branch Pettibone Creek Sediment Frequency of Detection – Site 17 .....A-48
A-8	South Branch Pettibone Creek Surface Water Frequency of Detection – Site 17.....A-50
A-9	Pettibone Creek Below Confluence Sediment Frequency of Detection – Site 17 .....A-51
A-10	Pettibone Creek Below Confluence Surface Water Frequency of Detection – Site 17 .....A-53
A-11	Boat Basin Sediment Frequency of Detection – Site 17.....A-54
A-12	Boat Basin Surface Water Frequency of Detection – Site 17 .....A-56
A-13	Project Target Parameters, Matrices, and Rationales – Site 7.....A-57
A-14	Project Target Parameters, Matrices, and Rationales – Site 17.....A-58
A-15	Detection Limits versus Risk Criteria .....A-59
A-16	Non-Calibration QC Sample Usage Frequencies and Acceptance Limits.....A-64
A-17	Laboratory Data Package Elements .....A-66
B-1	Surface Soil/Subsurface Soil Samples, Site 7 – RTC Silk Screening Shop .....B-37
B-2	Field Sample Summary – Soil, Site 7 – RTC Silk Screening Shop .....B-39
B-3	Well Summary, Site 7 – RTC Silk Screening Shop .....B-40
B-4	Ground Water Samples, Site 7 – RTC Silk Screening Shop .....B-41
B-5	Field Sample Summary - Ground Water, Site 7 – RTC Silk Screening Area .....B-42
B-6	Surface Water Samples, Site 17 – Pettibone Creek/Boat Basin .....B-43
B-7	Field Sample Summary - Surface Water, Site 17 – Pettibone Creek/Boat Basin .....B-44
B-8	Sediment Samples, Site 17 – Pettibone Creek/Boat Basin .....B-45
B-9	Field Sample Summary - Sediment, Site 17 – Pettibone Creek/Boat Basin .....B-50
B-10	Sample Containers, Preservation Methods, and Holding Times .....B-51
B-11	Summary of Organic, Inorganic, and Miscellaneous Analytical Procedures Solid and Aqueous Samples .....B-54

## TABLES (CONTINUED)

<b><u>NUMBER</u></b>	<b><u>PAGE NO.</u></b>
B-12	Quality Control Limits, Volatile Compounds, Matrix Spike/Matrix Spike Duplicates and Surrogate Spikes.....B-56
B-13	Quality Control Limits, Semivolatile Compounds, Matrix Spike/Matrix Spike Duplicates and Surrogate Spikes.....B-57
B-14	Quality Control Limits, Pesticide Compounds, Matrix Spike/Matrix Spike Duplicates and Surrogate Spikes.....B-59
B-15	Quality Control Limits, PCB Compounds, Matrix Spike/Matrix Spike Duplicates and Surrogate Spikes.....B-60
B-16	Quality Control Limits, Metals Compounds, Matrix Spike/Matrix Spike Duplicates .....B-61
B-17	Quality Control Limits, Volatile Compounds, Laboratory Control Samples .....B-62
B-18	Quality Control Limits, Semivolatile Compounds, Laboratory Control Samples.....B-63
B-19	Quality Control Limits, Pesticide Compounds, Laboratory Control Samples.....B-65
B-20	Quality Control Limits, PCB Compounds, Laboratory Control Samples .....B-66
B-21	Quality Control Limits, Metals Compounds, Laboratory Control Samples.....B-67
B-22	Laboratory Instrument Maintenance and Calibration.....B-68
C-1	Summary of Reports ..... C-5

## FIGURES

<b><u>NUMBER</u></b>	<b><u>PAGE NO.</u></b>
A-1	Project Organization Chart.....A-69
A-2	Site Location Map .....A-71
A-3	Site Map Site 7 - RTC Silk Screening Shop .....A-73
A-4	Site Map Site 17 - Pettibone Creek and Boat Basin .....A-75
A-5	Previous Sampling Locations Site 17 - Pettibone Creek and Boat Basin.....A-77
A-6	Site 7 and 22 Human Health Risk Assessment COPC Selection in Ground Water .....A-79
A-7	Site 7 and 22 Human Health Risk Assessment COPC Selection in Surface and Subsurface Soil .....A-80
A-8	Site 7 Ecological Risk Assessment COPC Selection for Surface Soil.....A-81
A-9	Site 7 Decision Rule for Establishing Nature and Extent of COPCS in Ground Water and Soils .....A-82
A-10	Site 7 and 22 Baseline Human Health Risk Assessment Decision Flow .....A-83
A-11	Site 7 and 22 Screening--Level and Step 3a Ecological Risk Assessment Decision Flow .....A-84
A-12	Site 17 Human Health Risk Assessment COPC Selection in Surface Water.....A-85
A-13	Site 17 Human Health Risk Assessment COPC Selection in Sediment.....A-86
A-14	Site 17 Ecological Risk Assessment COPC Selection for Sediment.....A-87
A-15	Site 17 Decision Rule for Establishing Nature and Extent of COPCS.....A-88
A-16	Site 17 Baseline Human Health Risk Assessment Decision Flow.....A-89
A-17	Site 17 Screening Level And Step 3a Ecological Risk Assessment Decision Flow .....A-90
A-18	Project Schedule .....A-91
B-1	Proposed Sample Locations – Site 7 - RTC Silk Screening Shop .....B-71
B-2	Proposed Sample Locations – Site 17 - Pettibone Creek and Boat Basin .....B-73
B-3	Proposed Surface Water Sample Locations - Site 17 - Pettibone Creek and Boat Basin.....B-75

## ACRONYMS

%R	Percent Recovery
AST	Above-ground Storage Tank
AVS/SEM	Acid-volatile sulfide/simultaneously extraction metals
AWQC	ambient water quality criteria
bgs	Below Ground Surface
BSFA	biota sediment accumulation factors
CERCLA	Comprehensive Environmental Response, Compensation, Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, Liability Information System
cfs	Cubic Feet per Second
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CLP	Contract Laboratory Program
COC	Chain of Custody
COC	Chemical of Concern
COPC	Chemicals of potential concern
CSF	cancer slope factor
CSM	Conceptual site model
CTC	certial tendency exposure
CTO	Contract Task Order
CWA	Clean Water Act
DAF	dilution and attenuation factors
DO	Dissolved Oxygen
DOT	Department of Transportation
DPT	Direct Push Technology
DQO	Data Quality Objectives
DRMO	Defense Reutilization and Marketing Organization
EPC	exposure point concentration
FOL	Field Operations Lead
FSP	Field Sampling Plan
GC / MS	Gas Chromatograph / Mass Spectroscopy
GPR	Ground Penetrating Radar
HASP	Health and Safety Plan
HI	hazard indices
HPLC	High Performance Liquid Chromatography



HQ	hazard quotient
HSA	hollow stem auger
HSDB	Hazardous Substance Data Base
IAS	Initial Assessment Study
ICP	Inductively Coupled Plasma
ICR	Incremental cancer risk
IDL	Instrument Detection Limit
IDW	Investigation Derived Waste
IEPA	Illinois Environmental Protection Agency
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
MCL	maximum concentration limit
MDL	Method Detection Limit
mg/kg	Milligram per kilogram
MNA	Monitored Natural Attenuation
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NCRS	North Chicago Refiners and Smelters
NEFSC	Naval Facilities Engineering Service Center
NIST	National Institute of Standards and Technology
NTC	Naval Training Center
OPPTS	Office of Prevention, Pesticides and Toxic Substances
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Completeness and Comparability
PCB	Polychlorinated Biphenyl
PDS	Post-digestion Spike
PE	Performance Evaluation
PID	photo ionization detector
PM	Project Manager
PPE	Personal Protection Equipment
PRG	Preliminary Remedial Goals
PWC	Public Works Center
QA	Quality Assurance

QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Risk Assessment
RAIS	Risk Assessment Information System
RBC	Risk-based concentration
RBTL	Risk-Based Target Levels
RCRA	Resource Conservation and Recovery Act
RfC	Reference Concentration
RfD	Reference Dose
RI	Remedial Investigation
RL	Reporting Limits
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RTC	Recruit Training Center
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SI	Site Inspection
Site 17	Pettibone Creek / Boat Basin
Site 7	RTC Silk Screen Shop
SOP	Standard Operating Procedure
SOUTHDIV	U.S. Navy Southern Division Naval Facilities Engineering Company
SOW	Statement of Work
SSL	Soil screening level
SSO	Site Safety Officer
STL	Severn Trent Laboratories
STS	STS Consultants Ltd.
SVOC	Semivolatile Organic Compound
TACO	Tiered Approach to Corrective Action Objectives
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
TOC	Total Organic Carbon

TOM	Task Order Manager
TSA	Technical System Audit
TtNUS	Tetra Tech NUS, Inc.
U.S. EPA	United States Environmental Protection Agency
U.S. Navy	United States Navy
UCL	Upper Confidence Limit
VOC	Volatile Organic Compound
WQS	Water Quality Standards

## **A. PROJECT MANAGEMENT**

### **A1 TITLE PAGE AND APPROVAL SHEET**

The title page and approval sheets are provided as the first page of this document.

### **A2 TABLE OF CONTENTS AND DOCUMENT CONTROL**

The table of contents, acronyms, list of appendices, list of tables, and list of figures are provide in the table of contents section.

### **A3 DISTRIBUTION LIST**

The distribution list for this document is provided in the transmittal letter that is located in the front of the document.

### **A4 PROJECT/TASK ORGANIZATION**

This section presents the project management responsibilities and organization for the Sites 7 and 17 Remedial Investigation and Risk Assessment (RI/RA) at Naval Training Center (NTC) Great Lakes. Staffing and coordination requirements are discussed in the following subsections.

#### **A4.A Management Responsibilities**

Tetra Tech NUS, Inc. (TtNUS) on behalf of the United States (U.S.) Navy, is responsible for the overall management, preparation of the Sites 7 and 17 Quality Assurance Project Plan (QAPP), and implementation of contract field activities. Navy personnel will be actively involved. The authorities and organizational relationships of key personnel are depicted on Figure A-1. Addresses and telephone numbers of key personnel are listed by organization in Table A-1. Responsibilities for program management, project management, field operations, and laboratory operations are discussed in the following sections. It is intended that the individuals named will perform the designated responsibilities to the extent that they are available to perform the stated activities.

##### **A4.A.1 U.S. EPA Project Manager**

The United States Environmental Protection Agency (U.S. EPA) Project Manager (PM), Mr. Owen Thompson, will oversee the implementation of the Sites 7 and 17 RI/RA at NTC Great Lakes. The

U.S. EPA PM represents the Agency's interests and will provide input from this perspective and lend general historical and technical assistance to NTC Great Lakes field activities.

#### **A4.A.2 Illinois Environmental Protection Agency Project Manager**

The Illinois Environmental Protection Agency (IEPA) Hazardous Waste PM, Mr. Brian Conrath, will oversee the implementation of the Sites 7 and 17 RI/RA. Mr. Leslie Morrow is a risk assessor who will assist Mr. Conrath. They represent IEPA's interests and will provide input from this perspective.

#### **A4.A.3 Navy Project Manager**

The Navy Remedial Project Manager (RPM), Mr. Anthony Robinson, will represent the U.S. Navy, providing management, technical direction, and oversight for the NTC Great Lakes project activities performed by contractors (i.e., TtNUS) and their subcontractors. In matters such as facilitation of site access and oversight, the Navy RPM is assisted by the NTC Great Lakes Environmental Site Manager, Mr. Mark Shultz. Additional responsibilities of the RPM are as follows:

- Define project objectives and develop a detailed QAPP schedule
- Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task
- Acquire and apply technical resources as needed to make sure performance remains within budget and schedule constraints
- Review the work performed on each task for its quality, responsiveness, and timeliness
- Review and analyze overall task performance with respect to planned requirements and authorizations
- Ultimately be responsible for the preparation and quality of draft and final reports
- Represent the project team at meetings and public hearings

#### **A4.A.4 Contractor Project Manager**

##### Program Manager

The TtNUS Navy Southern Division Comprehensive Long-Term Environmental Action Navy (CLEAN) Program Manager, Ms. Debbie Wroblewski, provides operations, technical, and administrative leadership, and oversees and supports quality policies. The Program Manager assigns project Task Order Managers (TOMs) and oversees their performance. The Program Manager also makes sure of the availability of technical and support resources for program operations, and maintains consistency in procedures and projects among Contract Task Order (CTO) assignments. In these matters, the Program Manager is assisted by the TOMs.

##### Task Order Manager (TOM)

The TtNUS TOM, Mr. Robert F. Davis, Jr., has overall responsibility for making sure that the project meets U.S. EPA and IEPA objectives, and Navy and TtNUS quality standards. The TOM is responsible for the preparation and distribution of the QAPP and RI/RA, at the direction of the Navy RPM, to project personnel, including subcontractors. The TOM will report to the Navy RPM and is responsible for technical QC and project oversight. Additional responsibilities of the TOM are as follows:

- Resolve project-related technical, quality, safety, or waste management issues
- Function as the primary interface with the Navy RPM and NTC Great Lakes Environmental Site Manager, field and office personnel, and subcontractor points-of-contact
- Communicate the health and safety issues related to this project to personnel and off-site laboratories
- Monitor and evaluate subcontractor laboratory performance
- Coordinate and oversee maintenance of project records
- Coordinate and oversee review of project deliverables
- Prepare and issue final deliverables to the Navy
- Approve the implementation of corrective actions

## **A4.B     Quality Assurance Responsibilities**

This section identifies the Quality Assurance (QA) responsibilities for this RI/RA. Responsibilities of the IEPA, TtNUS, and the analytical laboratories are discussed.

### **A4.B.1     IEPA Regional Project Manager**

The IEPA Regional PM, Mr. Brian Conrath, has the responsibility to review and approve the QAPP and to provide overall QA support and review. Additional responsibilities may include the following:

- Coordinate external performance and system audits of contracted laboratories
- Review and evaluate analytical field and laboratory procedures

### **A4.B.2     TtNUS QA Manager (QAM)**

The TtNUS Quality Assurance Manager (QAM), Mr. Paul Frank, is responsible for overall quality assurance for the project, and reports directly to the TtNUS Program Manager. He acts on behalf of the U.S. Navy for project quality assurance. The QAM is responsible to:

- Develop, maintain, and monitor QA policies and procedures
- Provide training to TtNUS staff in QA/quality control (QC) policies and procedures
- Conduct systems and performance audits to monitor compliance with environmental regulations, contractual requirements, QAPP requirements, and corporate policies and procedures
- Monitor the laboratory to make sure it maintains its approved status under the Navy's Installation Restoration Chemical Data Quality Manual program
- Audit project records
- Monitor subcontractor quality controls and records

- Assist in the development of corrective action plans and correct nonconformances reported in internal or external audits
- Oversee the implementation of the QAPP
- Oversee and review the development and revision of the QAPP
- Oversee the responsibilities of the TtNUS Site QA/QC Advisor
- Prepare QA reports for management

#### **A4.B.3 TtNUS Project QA Chemist**

The TtNUS Project Chemist, Ms. Angie Scheetz, supports the TOM in preparing and reviewing the QAPP, coordinating work performed by technical staff, and resolving matters concerning project chemistry. The Project Chemist also supports the Project QA Advisor on matters of QA/QC.

#### **A4.B.4 TtNUS Project QA Advisor**

The TtNUS Project QA Advisor, Dr. Tom Johnston, supports the TOM in preparing and reviewing the QAPP, and conducting data assessments. The Project QA Advisor communicates directly with the QAM on matters of QA/QC.

#### **A4.B.5 TtNUS Data Validation Coordinator**

The TtNUS Data Validation Coordinator, Mr. Joe Samchuck, receives the data from the laboratories and delegates data validation responsibilities to the appropriate data validators. The Data Validation Coordinator communicates directly with the TOM on matters of data validation.

#### **A4.C Field Responsibilities**

TtNUS will be responsible for the field activities related to this RI/RA. The TtNUS field team will be organized according to the activities planned. Field team members will be selected based on the type and extent of effort required. The team members will be appropriately skilled and trained for the tasks they are assigned to perform. The team will consist of a combination of the following personnel:

- Field Operations Leader (FOL)



- Site QA/QC Advisor
- Site Safety Officer (SSO)
- Field Technical Staff

#### **A4.C.1 Field Operations Leader (FOL)**

The FOL is responsible for coordinating the on-site personnel and for providing technical assistance, when required. The FOL, or designee, will coordinate and lead the sampling activities and will make sure of the availability and maintenance of the sampling materials and equipment. The FOL is responsible for completing all sampling, field, and chain of custody documentation, assumes custody of the samples, and makes sure of the proper handling and shipping of samples. The FOL reports directly to the TtNUS TOM. Specific FOL responsibilities include the following:

- Implement health and safety requirements unique to this site
- Function as the communications link between field staff members, SSO, the NTC Great Lakes Environmental Site Manager, and the TOM
- Alert off-site analytical laboratories of special health and safety hazards associated with environmental samples
- Oversee the mobilization and demobilization of the field equipment and subcontractors
- Coordinate and manage the Field Technical Staff
- Adhere to the work schedules provided by the TOM
- Maintain the site logbook, field logbook, and field record keeping
- Initiate field task modification requests when necessary
- Identify and resolve problems in the field; resolve difficulties via consultation with the NTC Great Lakes Environmental Site Manager; implement and document corrective action procedures; and provide communication between the field team and project management

#### **A4.C.2 Site QA/QC Advisor**

The FOL (or designee) will act as the site QA/QC Advisor, and will be responsible for adherence to the QA/QC requirements as defined in the QAPP. Strict adherence to these procedures is critical to the collection of acceptable and representative data. The following is a summary of the Site QA/QC Advisor's responsibilities:

- Collect field QC samples at the proper frequency
- Supply additional volumes of sample to the analytical laboratory with the proper frequency to accommodate laboratory QA/QC analyses
- Calibrate, use, and maintain measuring and test equipment in accordance with applicable procedures and technical standards
- Act as liaison between site personnel, laboratory personnel, and the QAM
- Manage bottleware shipments and oversee field sample preservation

#### **A4.C.3 Site Safety Officer (SSO)**

The FOL (or designee) will also serve as the SSO. The duties of the SSO are detailed in the Health and Safety Plan (HASP) (see Appendix VII). The SSO has stop work authority that will be executed upon the determination of an imminent safety hazard.

#### **A4.C.4 Field Technical Staff**

The field technical staff for this project will be drawn from TtNUS's pool of qualified personnel. The designated field team members will be experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

Field staff are responsible for complying with field-related requirements as presented in the QAPP and the HASP (see Appendix VII).

#### **A4.D      Laboratory Responsibilities**

Severn Trent Laboratories (STL) will perform the sample chemical analyses for this activity, except grain size and sediment toxicity test analyses (if necessary in a subsequent phase of the investigation). Grain size analyses will be conducted at a geotechnical laboratory. If it is determined that sediment toxicity testing is necessary at Site 17, Tetra Tech's laboratory in Owings Mill, Maryland will be used.

The subcontracted laboratories are responsible for maintaining their approval status under the Navy's Installation Restoration Chemical Data Quality Manual program and for analyzing the samples in accordance with the established analytical methods and additional requirements specified in the QAPP. It also will be the analytical laboratory's responsibility to properly dispose of unused sample aliquots. Responsibilities of key laboratory personnel are outlined in the following paragraphs.

##### **A4.D.1      Laboratory Project Manager**

The Laboratory PM, Ms. Veronica Bortot, will interface directly with the TtNUS TOM, QA Advisor, and Project Chemist and will perform the following:

- Communicate the proper method and project-specific requirements to laboratory personnel
- Make sure that laboratory resources are available on an as-required basis
- Make sure that Good Laboratory Procedures are adhered to
- Monitor analytical and project QA requirements
- Review data packages for completeness, clarity, and compliance with project requirements
- Inform the TtNUS TOM of project status and sample-receipt or analytical problems

##### **A4.D.2      Laboratory Operations Manager**

Responsibilities of the Laboratory Operations Manager include the following:

- Support the QA program within the laboratory
- Provide management overview of both production and quality-related laboratory activities
- Maintain adequate staffing to meet project analytical and quality objectives
- Approve the laboratory Standard Operation Procedures and QA documents
- Supervise in-house chain-of-custody documentation
- Oversee the preparation and approval of final analytical reports before submittal to TtNUS

#### **A4.D.3 Laboratory Quality Assurance Officer (QAO)**

The Laboratory Quality Assurance Officer (QAO) will report directly to the Laboratory Operations Manager. The Laboratory QAO will be independent of laboratory production management to make sure that laboratory quality performance is assessed without schedule and cost considerations. Responsibilities of the Laboratory QAO include the following:

- Define appropriate laboratory QA procedures and monitor overall laboratory QA
- Stop work if a condition adverse to the quality of work is encountered, if QA or QC procedures are not followed, or if analytical out-of-control events are encountered that have not been corrected
- Approve and maintain document control of QA documents and Standard Operating Procedures (SOPs)
- Perform and/or implement internal system and performance audits and verify completion of corrective actions cited in audits
- Direct laboratory participation in laboratory accreditation and certification programs

#### **A4.D.4 Laboratory Sample Custodian**

The Laboratory Sample Custodian will report to the Laboratory Operations Manager. Responsibilities of the Laboratory Sample Custodian include the following:

- Receive and inspect incoming sample containers
- Record the condition of incoming sample containers
- Sign appropriate documents
- Verify chain-of-custody
- Notify laboratory project manager of sample receipt and inspection

- Assign a unique identification number and customer number, and enter each into the sample receiving log
- Initiate transfer of the samples to appropriate lab sections, with the help of the laboratory project manager
- Control and monitor access/storage of samples and extracts

#### **A4.D.5 Laboratory Technical Staff**

The laboratory technical staff will be responsible for sample analysis based on the analytical methods and requirements specified in the QAPP.

#### **A4.E Special Training Requirements and Certifications**

The field personnel will have appropriate training to conduct the field activities that they are assigned. Additionally, each site worker will be required to have completed a 40-hour course (and 8-hour refresher, if applicable) in Health and Safety Training as described under Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(b)(4).

### **A5 PROBLEM DEFINITION/BACKGROUND INFORMATION**

This RI/RA is being conducted in accordance with the CLEAN III Contract Number N62467-94-D-0888, Statement of Work (SOW) #173 at the NTC Great Lakes, Great Lakes, Illinois and the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. EPA, 1988). This investigation will provide data on select organic and inorganic chemical concentrations in surface soils, subsurface soils, sediment, surface water, and/or ground water at two sites located within NTC Great Lakes: Site 7 Recruit Training Center (RTC) Silk Screen Shop and Site 17 Pettibone Creek and Boat Basin. Temporary monitoring wells will be installed for groundwater monitoring and soil samples will be collected using drilling equipment at the Site 7. Sediment and surface water samples will be collected at Site 17 in the Boat Basin and in Pettibone Creek. The sediment sample in the Boat Basin will be collected using drilling equipment and the samples in Pettibone Creek will be collected using hand tools. Figure A-2 shows the locations of both sites.

This investigation is intended to address the potential risks that are associated with Sites 7 and 17 only. The select organic and inorganic chemical data for the surface soils, subsurface soils, and ground water at Site 7 and sediment and surface water at Site 17 will be used to delineate the nature and extent of

contamination believed to be related to a Navy source and/or the risk-based criteria. The chemical data will also be used to implement a baseline human health risk assessment (see Appendix I), a screening-level ecological risk assessment, and Step 3A of the baseline ecological risk assessment (see Appendix II).

NTC Great Lakes is a U.S. Navy installation located within U.S. EPA Region 5. TtNUS has prepared this QAPP on behalf of the U.S. Navy Southern Division Naval Facilities Engineering Command (SOUTHDIR) and NTC Great Lakes to comply with U.S. EPA Region 5 requirements. Those requirements, and guidance, govern the aspects of RI/RA environmental investigations. In accordance with those requirements, project planning followed the U.S. EPA Data Quality Objectives (DQO) process (U.S. EPA, 1999b). That process requires explicit statements of the problem to be solved, the spatial and temporal boundaries related to the problem, the measurements to be made in solving the problem, and, when applicable, quantitative specifications of the tolerances for making decision errors. It culminates in a specification of decision rules and in a Field Sampling Plan (FSP) designed to solve the stated problem.

This QAPP presents the project organization, objectives, planned activities, and specific QA/QC procedures associated with sample collection and analysis for the investigation. Specific protocols for sample collection, sample handling and storage, chain of custody (COC), chemical analyses, and data evaluation and assessment are described. These protocols are specified to make sure that the data generated during this investigation are of the expected quality necessary to support project objectives.

#### **A5.A      Background Information**

NTC Great Lakes is located in Shields Township, Lake County, Illinois. Dedicated in 1911, it is the largest naval training center (1,650 acres) in the United States. It is bounded on the west by U.S. Route 41 (Skokie Highway), on the north by the City of North Chicago, on the south by the Veterans' Administration Hospital and Shore Acres Golf Course and Country Club, and on the east by Lake Michigan.

The terrain of NTC Great Lakes is a relatively flat glacial drift deposit bordered by steep lake-facing bluffs cut with steeply sloping ravines. The unconsolidated glacial material that makes up the bluff faces and ravine walls is constantly being eroded. Intensive development has replaced most of the oak, hickory, maple, and other hardwood woodlands. Native woodlands occur primarily on the steeply sloped ravine of Pettibone Creek, across the Mainside, and on the bluffs facing Lake Michigan. The banks of Pettibone Creek are forested with white oak, red oak, maple, European larch, and white and Scotch pine. Shrubs include raspberry and blackberry bushes. Wild grape and perennial weeds cover the slopes. The principal mammals in the area include groundhogs, raccoons, squirrels, opossums, rabbits, chipmunks,

and deer. Children and pets may play in Pettibone Creek, which supports minnows, aquatic insects, frogs, and salamanders. The water is slow moving due to low gradients, and stagnates during dry spells.

#### **A5.A.1 Site 7 RTC Silk Screen Shop**

In 1986, an Initial Assessment Study (IAS) conducted at the NTC Great Lakes identified 14 potentially contaminated sites. Each of these sites was evaluated with respect to contamination characteristics, migration pathways, and pollutant receptors. The study concluded that seven of these sites, including Site 7, warranted further investigation to assess potential long-term impacts.

Site 7 is bounded on the south by Building 1212, on the west by Indiana Street, on the north by a concrete vault and 8<sup>th</sup> Avenue, and on the east by Ohio Street (see Figure A-3). It serves as a parking lot and is covered with asphalt. Two gasoline aboveground storage tanks (ASTs) were located in a fenced area near Ohio Street, across from the former silk-screening shop drain. North of the ASTs is a fenced, unpaved storage area for trailers, equipment, soils, and logs, which extends northward to 8<sup>th</sup> Avenue. A concrete vault, housing steam pipes, is located between the AST area, 8<sup>th</sup> Avenue, and Ohio Street. Underground steam lines reportedly run in a north-south and east-west direction from the vault.

The RTC Silk Screening Shop has been located in the RTC Training Aids Branch in Building 1212 since 1943. Various flags and banners that recruits use during parades, graduation, etc. were made in this shop. While specific materials have changed over the years, they include water and oil-based lacquers and enamels, mineral spirits, acetone, bleach, linseed oil, alcohol, thinner, direct photographic emulsion, and ink products. From at least 1972 to 1985, the finished silk screens were washed in a booth located in the northeast corner of Building 1212, and the wash wastes passed through a drain that emptied onto the unpaved ground immediately outside of the building. The 2-inch drain was located in the bottom of the wash booth, penetrated the exterior wall, and ended in mid-air. Wastes generated from 1985 until the RTC Silk Screening Shop was closed around 1995 or 1996, were disposed of in a 55-gallon drum that was emptied by a private contractor hired through the Defense Reutilization and Marketing Organization (DRMO).

Thinners were used at the rate of 3 gallons per week during heavy work periods and left the building via the wash booth drain. Photographic emulsion was used at the rate of approximately 5 gallons per year and was washed out the drain. The waste flowed out of the drain at a rate of approximately 1,400 gallons per year. During busy periods, approximately 200 gallons per week of wash wastes were flushed out the drain and onto the ground. Thus, if this process began in 1972 and stopped in 1985, approximately 18,200 gallons of waste have been dumped onto the site.

The ground surrounding the drain outlet (an area approximately 3 feet by 15 feet) appeared stained in June 1985. Less obvious staining continued north and east into the dirt road behind the building where, reportedly, the effluent formed pools during periods of heavy discharge. These pools remained until they infiltrated the soil, were flushed away by precipitation, or evaporated.

The surface soils in this area are classified as made land (filled or developed) or silty loam. The in-situ loam is slowly-to-moderately permeable; however, there is no site-specific information that describes site soils and their permeability. Because of the tight nature of the surface materials, it is unlikely that waste that infiltrated the surface entered the glacial aquifers, which lie approximately 15 to 50 feet below the surface.

Direct exposure of personnel living in the Recruit Training Center camps is likely to be limited because of the inaccessibility of the area and the lack of idle time allocated to personnel in the area.

Dames & Moore conducted a RI Verification Step (Site Inspection) at Site 7 in 1988 and 1989. The project was to collect sufficient quantitative environmental data to verify the presence of hazardous or toxic waste and plan for an expanded monitoring program or recommend no further action if such materials were not found. The Site Inspection included the collection of two samples from three locations, one each from depths of 0.5 foot and 1.5 to 2 feet. Prior to sampling, the gravel surface was removed at each sample location (see Figure A-3). Analytical parameters included volatile organic compounds (VOCs), silver, chromium (total), cadmium, and lead. The laboratory (metaTRACE, Inc., Earth City, Missouri) chosen to perform the analyses was not able to produce sufficient QA/QC data to allow validation of the sample analytical data. The results from the laboratory are shown on Table A-2. Lead in one surface soil sample exceeded the Tiered Approach to Corrective Action Objectives (TACO) residential criteria.

On June 23, 1992, a gasoline spill occurred at an AST located near Site 7. During the excavation and removal of the gasoline-contaminated soils, a petroleum-like product was encountered at approximately 2 feet below grade. The cleanup operation was halted, and the partially-excavated area was backfilled with clean material (Halliburton NUS Corporation, 1994).

According to a Navy memorandum dated July 29, 1992, a vintage World War II gasoline station may have been located on the site. On June 28, 1994, the Halliburton NUS Team Project Manager and a geophysical scientist visually inspected the site and assessed the site conditions relative to a geophysical survey. Reported information indicated that underground storage tanks might be buried in the north-



central part of the existing parking lot. A Ground Penetrating Radar (GPR) investigation was performed at Site 7 on July 16, 1994 by RUST Environment and Infrastructure (Rust E & I, August 1994). The RUST report stated that "a group of anomalies...having radar signature strength sufficient to indicate a potential buried metallic object or objects. Because none of these anomalies shows a typical tank signature, we cannot be conclusive in identification." The RUST report concluded that further investigation of the area was warranted.

Brown & Root Environmental conducted sampling and analysis of surface soil at this site in December 1995. One surface soil sample (depth of 0 to 0.5 feet) was collected and analyzed for the Target Compound List (TCL) VOCs, semi-volatile organic compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs), and Target Analyte List (TAL) inorganics and cyanide to support the relative risk site evaluation program. The results of the analysis are shown on Table A-2 and indicate that five chemicals [inorganics and polynuclear aromatic hydrocarbons (PAHs)] exceed the TACO residential criteria (Brown & Root Environmental, 1996).

#### **A5.A.2 Site 17 Pettibone Creek and the Boat Basin**

##### Pettibone Creek

The majority of the NTC Great Lakes activities occur on a plateau atop a steep bluff that rises 70 feet above the beach. Pettibone Creek and its tributaries flow in a ravine that divides this plateau, and discharge to the Boat Basin (see Figure A-4).

Pettibone Creek has two major branches, the north and the south. The north branch originates in North Chicago near Commonwealth Avenue, flows south under Martin Luther King Jr. Drive and a parking area, resurfaces north of Sheridan Road, flows below Sheridan Road, resurfaces on the NTC Great Lakes property, and flows south and east through the NTC Great Lakes until it enters Lake Michigan. The south branch originates in the Shore Acres Country Club and flows north entering NTC Great Lakes near the intersection of G Street and 3<sup>rd</sup> Street.

In NTC Great Lakes, Pettibone Creek ranges between 15 and 30 feet wide, and several inches to two feet deep. Over 30 NTC Great Lakes stormwater sewer system outfalls drain to the creek. According to Illinois State Water Survey, the creek has a calculated average flow of less than 10 cubic feet per second (cfs).

Pettibone Creek is not used for drinking; however, children may play in the creek. Fish and frogs are present in the creek and fish may swim up the creek to spawn. No endangered or threatened species are recorded as occurring in the area. The highly developed nature of the general vicinity makes it unlikely that suitable habitat exists.

The urban nature of the creek's watershed has resulted in flash floods that have caused severe erosion and sedimentation problems. Efforts to stabilize the erosion in the ravine have been made in the past. In 1982, the NTC Great Lakes initiated emergency slope stabilization. In 1989, after a period of major storms in 1987 and 1988, emergency pipe replacement and slope stabilization measures were conducted in three severely eroded areas.

The stream sediments were classified as "Special Waste" because they were contaminated with various compounds and elements.

#### Boat Basin and Harbor Area

The original boat basin and harbor were constructed in 1906 with the outer breakwater structures added by 1923. The NTC Great Lakes Harbor is primarily for recreational water activities including motor and sail boating, fishing, swimming, and other water and beach activities. The harbor provides anchorage for about 270 watercraft and shore bulkheads for docking and berthing. Naval reservists are trained in small landing craft procedures and operations in the harbor. Reserve units conduct landing operations along the NTC Great Lakes shoreline.

The silting-in of the harbor has hampered these training operations. Extensive erosion of Pettibone Creek contributes to the silting-in of the harbor. The outer harbor anchorage already has reduced capacity, limiting the size of watercrafts that are able to be loaded/off-loaded at the recreational boat ramps. The harbor was dredged in the early 1950s and again in the early 1970s.

#### Boat Basin

The Harbor Area is divided into three areas: the Boat Basin, the Inner Harbor, and the Outer Harbor. The Boat Basin, which is approximately 2.6 acres, is the most protected portion of the Harbor. It served as an area for boat slips when the water was deeper. In June 1990, the water depth of the Boat Basin ranged from less than 1 foot to 5 feet. The eastern portion of the Boat Basin provided access to the boat repair building, but, now, accumulated sediment prevents access for most vessels. Public Works Center (PWC) Great Lakes has estimated that some 30,000 cubic yards of material would have to be dredged from the

boat basin to reestablish a desired water depth of 8 feet. Evidence from aerial photographs indicates that the boat basin would require dredging about once every 5 to 7 years to maintain that depth.

#### Inner Harbor

The Inner Harbor, which is approximately 5.9 acres, is occupied by floating slips during the boating season and is fished. A ship lift facility that services landing craft is located on the south side of the Inner Harbor. A boat hoist for small crafts is located on the north side. In June 1990, water depths ranged between 9 and 15 feet.

#### Outer Harbor

The Outer Harbor, which is approximately 78 acres and enclosed by breakwaters, contains numerous small craft moorings during the boating season. A boat ramp, used to launch recreational small craft, is located on the north side. In June 1990, water depths ranged between 1 and 25 feet.

#### Sampling Events

The data from prior sampling events are shown on Tables A-3 to A-12. These summary tables show the minimum, maximum, average, and frequency of detection chemicals sampled from for surface water and sediment in Pettibone Creek, South Branch of Pettibone Creek, and the Boat Basin, respectively. Each sampling event is discussed below. The locations of the samples are shown on Figure A-5.

#### 1970s Sampling

PCBs and pesticide residues were found in samples obtained by the IEPA in 1970 and 1971. Samples obtained by the U.S. EPA at the NTC Great Lakes in 1975 indicated that the Inner Harbor sediments were heavily polluted with toxic metals. An U.S. EPA contractor collected sediment samples from Pettibone Creek upstream of the inner harbor on May 22, 1980.

#### STS Sampling Events

CWA Section 401/404 Sampling, April 1988 - STS Consultants Ltd. (STS) sampled to support an application for a Clean Water Act (CWA) Section 401/404 permit to dredge the Boat Basin and the Outer Harbor. On April 20, 1988, they collected one grab sample from the Boat Basin and one from the Outer Harbor for priority pollutant metals, PCBs, and limited EP toxicity testing. The levels for copper, cyanide, lead, nickel, and zinc in both samples exceeded the 1977 U.S. EPA guidelines for classifying Great Lakes

harbor sediments as "nonpolluted". The PCB concentration detected in sample B-2 also exceeded the 1977 guidelines. Results of the limited EP toxicity testing indicated that the sediment samples were not considered hazardous relevant to chromium, lead, or mercury. U.S. EPA would not approve open water disposal of these sediments, however the dredged materials could be disposed of in a licensed, non-hazardous landfill facility.

STS Sampling Event, April 1989 - Seven composite sediment samples (three from the Boat Basin and four from the Outer Harbor), and one Lake Michigan surface water sample, and one background sediment sample (both from south of the south Outer Harbor breakwater) were collected on April 19 and 20, 1989. The samples were analyzed for metals, PAHs, pesticides, and PCBs. The background sediment sample was collected at a depth of 1 foot, and the other sediment samples were composites of samples collected from a sediment depth of 0 to 5 feet. Supernatant testing and analysis of metals, total suspended solids, total volatile solids, and ammonia-nitrogen were conducted for Outer Harbor samples with fine materials in excess of 20 percent (B-104, B-105, and B-106). The levels of detectable metals in the Boat Basin sediment samples were generally higher than those collected in the Outer Harbor. Within the Boat Basin, the highest levels were generally found at B-104 location where the basin bends at about 45 degrees to join a channel leading to the Inner Harbor. Metal levels in sediment sample B-105 (next to the mouth of the Inner Harbor) were the highest among the Outer Harbor sediment samples. Several semivolatile organic compounds were detected at low mg/kg concentrations. PCBs were not detected in the sediment samples.

STS Sampling Event, December 1989 - Seven composite sediment samples (three from the Boat Basin and four from the Outer Harbor) and one Lake Michigan surface water sample (from south of the south breakwater) were collected on December 5 and 6, 1989 and analyzed for supernatant metals, PCBs, and PAHs. Each composite sample was comprised of grab samples from a sediment depth of 0 to 5 feet. Direct comparison of the supernatant test results with the IEPA maximum allowable concentrations indicated that the IEPA was not likely to permit open water disposal of the sediments.

#### Water Quality Study, June 1990

The Bureau of Water Planning section performed a water quality study that showed elevated concentrations of zinc, copper, and lead, particularly in the sediments downstream of the North Chicago Refiners and Smelters (NCRS).

#### Site Inspection, August 1992

Between August 17 and 26, 1992, Halliburton NUS conducted a Site Inspection (SI) at Pettibone Creek, the Boat Basin, the Inner Harbor, the Outer Harbor, and Lake Michigan. They collected 11 sediment samples and 11 surface water samples from Pettibone Creek; 8 sediment samples and 2 surface water samples from the Boat Basin; 8 sediment samples and 2 surface water samples from the Inner Harbor; 11 sediment samples and two surface water samples from the Outer Harbor; and 6 sediment samples and 5 surface water samples from Lake Michigan. The samples were analyzed for one or more of the following parameter groups: TCL VOCs, SVOCs, pesticides, and PCBs; TAL metals and cyanide; Toxicity Characteristic Leaching Procedure (TCLP) VOCs, SVOCs, herbicides, pesticides, and metals; reactivity; supernatant parameters; elutriate parameters; and miscellaneous parameters (i.e. total organic carbon and particle size).

#### Expanded Site Inspection (NCRS), April 1994

The IEPA conducted an Expanded Site Inspection of the NCRS site in April 1994. They collected nine surface soil samples from the residential area north-northwest of the NCRS facility, two background soil samples, seven sediment samples from Pettibone Creek, two background samples from tributaries to the creek, and one sample from the Inner Harbor. Contaminants detected in the soil samples included VOCs and SVOCs, pesticides, PCBs, and inorganic compounds. Analyses of the sediment samples revealed the presence of VOCs and SVOCs, pesticides, PCBs, metals, and other organic compounds.

#### **A5.A.3 Upstream Industries**

The NCRS site consists of the current NCRS facility, the property west of the facility (Vacant Lot and Fansteel) extending to Commonwealth Road, and a portion of the residential area located north-northwest of the NCRS facility.

Historical records show that non-ferrous smelting and refining operations have occurred at the site since the late 1800s. The following is a timeline of property ownership:

- |             |   |
|-------------|---|
| 1892 – 1905 | Lanyon Zinc Oxide Co. - produced 150-175 barrels of zinc oxide per day.   |
| 1905 – 1925 | Vulcan-Louisville Smelting Co.  |
| 1925 – 1941 | Vulcan Ingot Metal Co. – during this period the property was divided into three parcels: the western-most parcel being the current vacant lot, the middle being the current Fansteel property, and the eastern-most being the current NCRS property |

### Vacant Lot

Vulcan-Louisville Smelting owned the property at the corner of Commonwealth and Martin Luther King Jr. Drive, known as the Vacant Lot, as late as 1929. By 1936, the property was transferred to the Chicago, North Shore and Milwaukee Railroad Co. Sometime between 1936 and 1954, the property was sold to an individual who made it into a parking lot. During this period, an unknown fill material was brought to the lot. Tailings/cinder-like material can be found in areas of the lot, but in some areas it is only at the surface. Additionally, a heap of cinder material, approximately 170 X 56 X 4 feet, is present at the site. Currently, Northern Trust Bank in Lake Forest, IL holds the title to the property as the trustee for John Stack.

Borings obtained from the property in 1989 revealed the presence of fill material consisting of black coarse sand. An IEPA Emergency Response Unit incident log indicates that the "area was filled in years ago with what appears to be materials similar to fly ash, foundry sand." The Lake County Soil Survey classifies the entire site as "made land." In 1988, a fire broke out at the lot, and firefighters determined that subsurface material had become hot enough to ignite nearby brush. CERCLA investigations include a 1991 preliminary assessment and a 1993 integrated assessment that revealed the presence of VOCs, SVOCs, pesticides, PCBs, and various metals.

Pettibone Creek runs through the vacant lot from north to south. Surface runoff from the lot enters the creek directly or from Martin Luther King Jr. Drive.

### Fansteel

Around 1941, the western portion of the remaining Vulcan-Louisville Smelting property was transferred to the Tantalum Defense Corp., a subsidiary of Fansteel. The Fansteel facility dates back to 1942 when the U.S. Government authorized and financed its construction, which was actually an expansion of the already-existing Fansteel facility located south of Martin Luther King Jr. Drive. The facility produced tantalum mill products and formed non-ferrous metals until November 1990. The facility remains as the company's headquarters.

Surface runoff from the Fansteel property flows south to Martin Luther King Jr. Drive where it enters a stormwater outfall and discharges into Pettibone Creek.

### North Chicago Refiners & Smelters

In 1941, R. Lavin & Sons (a division of NCRS) assumed the leases on the remaining property and engaged in the smelting and refining of non-ferrous scrap metals and the manufacture of brass and bronze ingots. The facility occupies approximately 18 acres bordered to the north by the Elgin, Joliet & Eastern Railroad, to the south by Martin Luther King Jr. Drive, to the west by the Fansteel, Inc. office building, and to the east by commercial property along Sheridan Road. Much of the operational portion of the facility is paved. Prominent site features include a slag pile, two connected surface impoundments, a process building, warehouses, and an office building.

Borings taken from the facility in 1989 show a layer of fill material consisting of clayey, silty foundry sand, slag, gravel, and fragments of wood, rope, and brick from the surface to depths of 3.5 to 8 feet.

The NCRS facility has four discharge points into Pettibone Creek:

- 001- the reservoir tank into the southeast impoundment;
- 002- the southeast impoundment to the storm sewer tributary of Pettibone Creek;
- 003- the storm sewer system; and
- 004- another storm sewer.

The facility's NPDES permit expired in 1990 and only included outfalls 001 and 002.

Outfall 001 is overflow from a reservoir. Operations include recycling and reusing water for direct ingot cooling, smoke spray towers, flue trail dumpers, press heat exchangers, zinc die cast molds, cupola water jackets, and cupola slag granulation. Ideally, the water is recirculated through the system. However, hydraulic overload caused by precipitation or process difficulties has led the reservoir to overflow into the 002 ditch, which can overflow to the storm sewer.

Outfall 002 is the overflow from the 001 receiving ditch that also receives storm water runoff via storm sewers on the property. Some of the drainage area includes Warehouses I and II, the concentrator building, the furnace building, and leachate and groundwater from filled wetlands.

Outfalls 003 and 004 receive only storm water. Outfall 003 is located in the southeast section of the property, just south of the 002 discharge, and collects runoff from the hazardous waste storage area. Outfall 004 is located in the northeast section of the property near the parking lot entrance. Schematics

show this outfall receives the majority of area runoff, including the railroad receiving dock, both bag houses, and the parking lot.

In July 1988, Jacobs Engineering collected surface soil and sediment samples from the site. In August 1990, the IEPA listed the site on the Comprehensive Environmental Response, Compensation and Liability Act Information System (CERCLIS) because of non-compliance under RCRA. IEPA has identified three former waste piles, the former north settling pond, and the ditch both south and southeast of the concentrator building as hazardous waste management units.

A Consent Order was implemented in October 1990, and the company began working with the IEPA's RCRA Permit Section to address certain environmental concerns within the boundaries of the facility. The Consent Order required that the site close completely by July 1, 1996. Closure activities involved paving most areas of the site and monitoring groundwater.

A preliminary investigation was conducted in 1990 to characterize potential sources of contamination. Field activities included the collection of (1) surface water and sediment samples from the drainage ditch located at the southeastern portion of the site; (2) soil samples throughout the facility property; and (3) soil samples at selected locations.

On November 13-14, 1991, IEPA collected 18 soil samples and analyzed them for the TCL at the IEPA laboratories in Springfield (organics) and Champaign (inorganics). Sediment from the southeast surface impoundment at the NCRS facility was sampled. The results revealed that cadmium, calcium, chromium, copper, lead, magnesium, nickel, silver, and zinc were present at concentrations at least three times above the background concentrations. Sediments from the southwest impoundment were also sampled. The results revealed that 2-methylnaphthalene, beryllium, calcium, chromium, copper, lead, nickel, silver, and zinc were present at concentrations at least three times above background concentrations. Groundwater samples from monitoring wells screened in the shallow and deep aquifers were also collected on the NCRS site in the winter of 1991-1992.

#### Industrial Park

IEPA asserts that NCRS is not the only contributor of contaminants to Pettibone Creek. Many of the organics appear to be from the industrial park west of the NTC Great Lakes. Pesticides appear to be coming from the NTC Great Lakes property. The area located east of the headwaters is contaminated and under CERCLA investigation, however, its effect on Pettibone Creek appears to be minimal in



comparison to NCRS. However, none of the other sites that drain to Pettibone Creek exhibit the concentrations of metals, associated with NCRS.

#### **A5.B      Project Problem Statement**

Because of known, operationally related chemical releases at Sites 7 and 17, risks to human and ecological receptors could be unacceptable. The risks are expected to be confined primarily to aqueous and solid media because only minimal airborne release pathways (e.g., occasional minor resuspension of dust or release) are anticipated.

The degree of risk to a human or ecological receptor is determined based on the nature of contamination and the frequency, duration, and nature of exposure to contaminants. Consequently, it is important to understand where receptors could be exposed to the contaminants. This requires that the extent of contamination be established. In this context, extent will be established relative to numerical risk-based criteria. A risk evaluation must be conducted for human and ecological receptors in contaminated areas to determine whether risks posed by exposure of those receptors to site contaminants are unacceptable. Plausible land use scenarios must be considered when identifying the receptors that could be at risk.

Past sampling, although limited in some areas, identified the presence of select contaminants at Sites 7 and 17. Previous sampling has not been adequate to delineate the extent of contamination. This investigation is designed to further delineate the nature and extent of contamination in surface water, ground water, soil, and sediment believed to be related to a Navy source and/or the risk-based criteria. It is also designed to provide information to implement a baseline human health risk assessment (see Appendix I), a screening-level ecological risk assessment, and Step 3A of the baseline ecological risk assessment (see Appendix II). Because of these two general objectives, several decision statements have been developed for this project that apply to multiple environmental media. The decision statements that will facilitate attainment of the project objectives are shown on Figures A-6 to A-11 for Site 7 and Figures A-12 to A-17 for Site 17.

#### **Project Status/Phase**

One round of sampling is expected for this investigation. The need for additional sampling rounds will depend on whether the extent of contamination is established within prescribed bounds of the data quality objectives. The strategy for additional sampling rounds will be similar when establishing extent of contamination.

## **A6 PROJECT/TASK DESCRIPTION**

This section of the QAPP provides a general overview of the activities that were conducted to plan the project and the activities that will be performed.

### **A6.A Project Planning**

#### **A6.A.1 Project Planning Summary**

TtNUS, the Navy, and the IEPA project planners followed the U.S. EPA seven step DQO process (U.S. EPA, 2000) when developing the project technical requirements. A concise summary of the process is presented in Section A7.

#### **A6.A.2 Project Target Parameters**

Detailed lists of target analytes and associated environmental matrices specific to the individual sites are presented in Tables A-13 and A-14. It was important to select for use analytical methods that would provide comparability of data. The methods were also selected to be readily implementable by STL. Furthermore, the project planners did not identify a need to develop special laboratory methods. A diligent attempt was made to select analytical methods that would provide detection limits low enough to allow for measuring chemical concentrations at least as low as the risk-based target levels presented in Table A-15. Sometimes this was not possible. However, the observed discrepancies are not unusual and are discussed further.

#### **A6.A.3 Project Target Matrices**

The matrices and chemicals to be analyzed in this project were selected to support the project objectives. Those objectives are generally to establish the nature and extent of contamination based on risk-based criteria and to evaluate the risk to human and ecological receptors from exposure to potential site contaminants. Specific objectives are discussed in relation to the individual sites being investigated.

For Site 7 the matrices to be sampled are ground water, surface soil, and subsurface soil. For Site 17 the matrices to be sampled are surface water and sediment. For each site, the selected matrices are those that could have been impacted by releases of chemical contaminants and that could also pose a risk to human or ecological receptors.

#### **A6.A.4 Special Project Target Analytes**

Detailed lists of target analytes and associated environmental matrices specific to the individual sites (7 and 17) are presented in Tables A-13 and A-14. No special analytical methods will be used in support of this investigation. In general, the methods selected are standard U.S. EPA methods. The selected methods are suitable for measuring the selected target analytes in the matrices of interest at the concentration levels of interest.

Some analytical measurements will be made in the field. Field measurements are designed for three basis purposes:

1. to support health and safety functions
2. to provide screening level information to make sure that ground water sampling conditions are stable before ground water samples are collected,
3. to direct VOC sampling from soil and sediment matrices.

None of the field analytical results will be used directly in establishing the nature and extent of contamination or in evaluating risks. Field and laboratory analytical tasks are differentiated and delineated in Section B of this QAPP.

#### **A6.A.5 Data Validation / Verification**

Validation of analytical data will be completed by the TtNUS Chemistry Department located in TtNUS's Pittsburgh, Pennsylvania office. Final review and approval of validation deliverables will be completed by the Department's Data Validation Coordinator. Ten percent of the data will undergo full validation.

TtNUS will perform data validation according to the most recent U.S. EPA Region 5 guidelines to make sure that the analytical results meet the DQOs for risk assessment. Inorganic results will be validated according to the U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (U.S. EPA, 1994) with consideration to Region 5 Standard Operating Procedure for Validation of CLP Inorganic Data (U.S. EPA, 1993). Organic results will be validated according to the U.S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (U.S. EPA, 1999b) with consideration to Region 5 Standard Operating Procedure for Validation of CLP Organic Data, (U.S. EPA, 1993). The analytical results for the remaining parameters will be validated according to

the applicable analytical methods. Validation of these data will conform to the National Functional Guidelines to the greatest extent practicable.

#### **A6.A.6 Quality Assurance Assessment Summary**

Performance and system audits will be conducted periodically to make sure that work is being implemented in accordance with the approved QAPP and in an overall satisfactory manner.

The TtNUS QAM or designee may perform Internal Field Technical System Audits (TSA) to make sure that sample collection, handling and shipping, equipment decontamination, and field documentation procedures are being performed in accordance with the approved QAPP and SOPs (see the field audit table in Appendix V for the audit procedures). The U.S. EPA, IEPA, or Navy may conduct external field audits at their discretion during field operations. Audit reports will be distributed to the U.S. EPA Region 5 PM, IEPA PM, Navy RPM, and the TtNUS TOM and QAM (Owen Thompson – U.S. EPA, Brian Conrath – IEPA, Anthony Robinson – Navy RPM, Robert Davis – TtNUS TOM, and Paul Frank – TtNUS QAM).

The laboratory QAO or designee may conduct routine internal audits of the laboratory (see Appendix IV, the Laboratory Quality Manual for audit procedures). The U.S. Navy, through Naval Facilities Engineering Service Center (NEFSC), may also conduct on-site laboratory audits to make sure that the subcontracted laboratory is complying with good laboratory practices and is providing the general analytical services requirements laboratory (see Appendix IV for the Navy Installation Restoration Chemical Data Quality Manual and Department of Defense Quality Systems Manual for Environmental Laboratories on audit procedures). Audit reports will be distributed to the U.S. EPA Region 5 PM, IEPA PM, Navy RPM, the TtNUS TOM and QAM, and the laboratory PM and QAO at STL Laboratories (Owen Thompson – U.S. EPA, Brian Conrath – IEPA, Anthony Robinson – Navy RPM, Robert Davis – TtNUS TOM, Paul Frank – TtNUS QAM, Laboratory PM - Veronica Bortot, and laboratory QAO - Patrick Conlon). The IEPA may perform on-site laboratory audits at their discretion.

Data packages will be reviewed for completeness and evaluated against project-specific quality specifications. The Data Validation Manager will review each data validation report for consistency with project objectives and for accuracy.

#### **A6.A.7 DQO Reconciliation**

After data validation, the data will be reconciled with DQOs to determine whether sufficient data of acceptable quality are available for making decisions. In concert with or in addition to the Precision,

Accuracy, Representativeness, Completeness, and Comparability (PARCC) parameter evaluations described in Section A7, a series of inspections and statistical analyses will be performed to estimate several of the data set characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as the maximum concentration, minimum concentration, number of samples exhibiting no detectable analyte, the number of samples exhibiting detectable analytes, and the proportion of samples with detectable and undetectable analytes. The data will be presented in a tabular format. Details of the DQO reconciliation evaluations are presented in Section D3.

#### **A6.A.8 Project Reports**

Field and laboratory reports have been discussed in previous sections. The information from the field and laboratory reports and evaluation of the data will be summarized and assessed to determine whether additional data collection is required for determining the extent of contamination at Site 7 and Site 17. A RI/RA report will be issued summarizing the findings of the investigations. If contamination is detected, the locations, concentrations, and boundaries of representative contaminants will be described and depicted on summary maps and diagrams, as appropriate. The results of ground water, surface water, sediment, and soil data evaluations used to estimate contaminant concentrations relative to regulatory criteria and background values at the study areas will be summarized. Discussions among U. S. EPA Region 5, IEPA, Navy, NTC Great Lakes, and TtNUS concerning the need for future investigations will be summarized, and, if appropriate, recommendations for future investigations will be presented. Recipients of the RI/RA report will include U.S. EPA Region 5, IEPA, Navy SOUTHDIV, NTC Great Lakes, and TtNUS.

#### **A6.B Schedule**

The schedule for preparation of the QAPP, implementation of the field work and laboratory analysis, evaluation of the data, and preparation of the RI/RA report is shown on Figure A-18. The schedule includes approximately 60 days for regulatory review of the draft QAPP and RI/RA report, as well as time for several meetings to discuss the project. Project delays will be communicated by the TtNUS TOM to the Navy RPM, IEPA PM, and U.S. EPA PM.

### **A7 DQO/PARCC SUMMARY**

The U.S. EPA DQO process was used when planning this investigation (U.S. EPA, 2000). The DQO process comprises seven steps designed to elucidate in an organized manner the correct type, quantity, and quality of data that must be evaluated to resolve the problem being investigated. The seven steps of the process are (paraphrased):

1. State the problem
2. Identify the decision
3. Identify the inputs to the decision
4. Establish the study area boundaries
5. Develop a decision rule
6. Establish tolerable decision error limits
7. Select a cost-effective sampling design

Step 6 is only necessary when a statistically based sampling plan is developed.

The DQO process outputs addressing these seven steps for the Site 7 and Site 17 investigations are presented in Appendix III. Those DQO outputs form the basis for this QAPP.

The individual PARCC parameters are defined below and the manner in which individual quantitative PARCC parameter values are computed is described in terms of mathematical equations.

#### **A7.A      Precision Assessment**

Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions. A fundamental tenet of using precision measurements for quality control is that precision will be bounded by known limits. Results outside these predetermined limits trigger corrective actions.

By definition, chemical solutions are uniform in composition. Therefore, ignoring the imprecision caused by the sample matrix, the variability of analytical results for duplicate dissolved water samples should be relatively low unless suspended material or sample handling and storage introduce additional imprecision. Precision acceptance criteria for aqueous duplicate samples have been assigned accordingly in Table A-16. Failure to achieve comparable concentration values in duplicate samples will trigger an evaluation of the source of imprecision and whether the imprecision has a negative impact on data usability. If the data are compromised, resampling may occur or the data may be qualified for use in accordance with data validation guidelines.

Because of the inherent and unknown heterogeneity of soil and sediment samples, the precision of soil and sediment field duplicate samples will not be used for quality control. Instead, field precision will be compared to laboratory precision to gain perspective on the natural heterogeneity of the soil or sediment.

Although precision for soil and sediment samples will not be used for QC purposes, acceptance criteria have been incorporated into Table A-16. Precision estimates exceeding the acceptance limits will cause the data to be qualified in accordance with data validation guidelines. The data qualifiers will warn data users when the measures of precision are becoming relatively large.

Laboratory duplicate samples (for inorganic analyses) and Matrix Spike Duplicate (MSD) samples (for organic analyses) will be prepared and analyzed at a minimum frequency of 1 per every 20 environmental samples per matrix. Field duplicate samples will be collected at a minimum frequency of 1 per 10 environmental samples per matrix. The relative percent difference (RPD) between a sample or Matrix Spike (MS) (Sample 1) and its duplicate or MSD (Sample 2) is calculated for chemical analyses using to the following formula:

$$RPD = \frac{|\text{Concentration in Sample 1} - \text{Concentration in Sample 2}|}{0.5 (\text{Concentration in Sample 1} + \text{Concentration in Sample 2})} \times 100 \%$$

The RPD estimate obtained from field duplicate samples encompasses the combined uncertainty associated with sample collection, homogenization, splitting, handling, field and laboratory storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, subsampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties. Consequently, the field precision estimates (i.e. RPD values) should equal or exceed the laboratory precision estimates, on average, for each analyte. If field duplicate precision is significantly less than laboratory duplicate precision, the underlying cause will be investigated to determine whether the observed difference could be artifacts of sampling or analysis. Considerations given to this effort would include the following:

- The scale of subsampling for laboratory precision estimates relative to the scale of field duplicate sample size
- Analytical measurement precision
- Precision for repeat analysis of the same solid laboratory control sample (LCS)
- Estimated environmental sample grain size relative to LCS grain size
- Potential natural soil heterogeneity
- Concentration level of the analyte

## **A7.B      Accuracy Assessment**

Accuracy is the degree of agreement between an observed value and an accepted reference value. Sample collection accuracy cannot be evaluated because there is no standard by which to judge such accuracy. Instead of a quantitative evaluation of sample collection accuracy, compliance with field SOPs will be the metric for evaluating sample collection accuracy.

Accuracy requirements for field measurements will be controlled through sample collection and handling and through routine instrument calibration. In addition, after completing field measurements identified in the SOP, a check standard will be analyzed to verify continued acceptable calibrations. Accuracy acceptance criteria are specified in the field measurement SOPs. Accuracy of grain size for soils is controlled by requiring that a qualified field geologist make those classifications. Field measurement test kits are used in accordance with the test kit manufacturer's instructions included in the kits.

Field accuracy is also typically monitored through the use of blanks to detect cross-contamination and by monitoring adherence to procedures that prevent sample contamination or degradation. Equipment rinsate blanks shall be collected for this investigation to assess cross-contamination via sample collection equipment. Ambient condition blanks will not be collected unless site conditions during sampling (e.g., generation of fugitive dust) indicate a need to assess infiltration of airborne contaminants into sampling containers. Source water blanks will be collected to monitor the purity of water used to decontaminate sampling equipment. Trip blanks, used to gauge whether cross-contamination is occurring during sample storage and transport, will be placed into each cooler containing samples to be analyzed for VOCs. Accuracy shall also be controlled qualitatively through adherence to sample handling, preservation, and holding time requirements. Failure to comply with accuracy requirements in the field will trigger an evaluation of the impact of the failure. This response is usually implemented in real time to minimize any negative impact on data quality and the ability to achieve project objectives.

Accuracy in the laboratory is measured through the comparison of a spiked sample or LCS result to a known or calculated value and is expressed as a percent recovery (%R). It is also assessed by monitoring the analytical recovery of select surrogate compounds added to samples that are analyzed by organic chromatographic methods. Sample preparation blanks and calibration blanks will be used to infer the potential for positive biases because of contamination. LCSs are used to assess the accuracy of laboratory operations with minimal sample matrix effects. MS and surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Post-digestion spikes (PDSs) are used to assess the accuracy of the analytical measurement on the sample extract or digestate. Each spike sample shall be fortified with representative



project target analytes for the analysis being performed to make certain that accuracy measures are obtained for each target analyte. Spiking concentrations shall equal or approximate the default concentrations detailed in the applicable sample preparation or analysis SOPs (Appendix IV).

The equations for determining accuracy of an individual MS and a surrogate spike or LCS for this project are presented below. The equations do not apply to blank samples, however, because division by zero (the expected amount or added amount) causes the calculated value to be infinite, regardless of the measured analyte concentration. Instead, acceptance criteria for blanks are designed to limit the tolerable amount of contamination while recognizing that non-zero results for blanks are likely, if only because of random error in the measurement process. The laboratory analytical SOPs (Appendix IV) limit tolerable blank concentrations. Data validation requirements will also be applied to blank results to evaluate the potential impact of contamination.

The %R for a spiked sample is calculated by using the following formula:

$$\%R = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \times 100 \%$$

The %R calculation for LCSs and surrogate spikes is as follows:

$$\%R = \frac{\text{Experimental Concentration}}{\text{Certified or Known Concentration}} \times 100 \%$$

LCS and MS analyses are performed at a frequency no less than 1 per 20 associated samples of like matrix. Laboratory accuracy is assessed by comparing calculated %R values to accuracy control limits specified in Table A-16. Failure to meet the acceptance limits will trigger corrective actions designed to either eliminate the problem or to assess the impact of the failure on the data quality or the ability to achieve project objectives.

#### **A7.C Representativeness Assessment**

Representativeness is an expression of the degree to which the data accurately and precisely represent a characteristic of a population or environmental condition at a site. Good representativeness is dependent on the proper design of the sampling program. Adherence to the FSP and use of standardized sampling, handling, preparation, analysis, and reporting procedures makes certain that the final data accurately represent the desired population or condition. Representativeness will be evaluated during data

assessment by outlier testing to determine whether each datum belongs to the observed data distribution. The statistical tests to be used are described in Section D3. Anomalies will be investigated to assess their impact on statistical computations.

Soil and sediment samples will be collected in accordance with SOPs and at the depth intervals stipulated in the FSP. It is sometimes impossible to collect soil from a particular depth interval. Such instances will be documented in the field logs. When this occurs, the data will be evaluated for suitability for decision making. Groundwater well stabilization parameters (dissolved oxygen, pH, specific conductance, temperature, turbidity) will be monitored to make certain that they have attained equilibrium prior to sampling.

Representativeness in the laboratory is achieved by using the proper analytical procedures and meeting prescribed sample holding times. Duplicate laboratory sample results also will be compared to duplicate field sample results to determine the degree of comparability, as described in Section A7.E. During development of this QAPP, representativeness of the data generated was evaluated by considering past operations, site photographs, existing analytical data, physical setting, soil depositional environments, monitoring well placement, spatial coverage of the proposed sampling locations, accessibility to sampling locations, and constraints inherent to the Comprehensive Environmental Response Compensation, Liability Act (CERCLA) program. For example, although Contract Laboratory Program (CLP) analytical methods are commonly used in CERCLA investigations, it was determined that lower detection limits could be routinely obtained by using Resource Conservation and Recovery Act (RCRA) analytical methods. The overall rationale of the sampling network is presented in detail in the FSP.

#### **A7.D Completeness Assessment**

Completeness is a measure of the amount of usable, valid analytical data obtained compared to the amount expected to be obtained. Completeness is expressed as a percentage. Completeness for this project will be determined based on the number of sample results for each target analyte and each sample type that are usable as determined through data validation and data assessment. Data values rejected during data validation (indicated by an "R" or "UR" flag) will be considered unusable unless additional review and documentation by one or more technical team members demonstrates that the rejection was erroneous. To monitor completeness, the number of usable, valid results for each soil type and analyte will be counted and compared to the project completeness objectives.

Failure to document soil grain size may be correctable by inspecting field logs and site maps, or through laboratory measurement once the laboratory receives the samples. Failure to obtain 100 percent of these

measurements from field samples may indicate a need for corrective actions designed to recover the missing information. Failure to recover the information will constitute a need to resample, unless the missing data are judged not to adversely affect attainment of project objectives.

Turbidity in ground water is a critical parameter that must be measured prior to sampling to establish attainment of equilibrium. The completeness criterion for groundwater turbidity measurements made in the field is 100 percent. There are no completeness criteria for dissolved oxygen, nitrate, flow rate, oxidation-reduction potential, water level, alkalinity, carbon dioxide, ferrous iron, hydrogen sulfide, nitrite, sulfate, pH, specific conductance, or temperature. These noncritical parameters are generally determined to verify that appropriate sampling conditions exist prior to sampling, or to provide data to evaluate the potential efficacy of monitored natural attenuation (MNA) as a remedial option. MNA parameters will not be measured in the initial RI sampling event but may be measured in subsequent sampling rounds if chlorinated organic solvents are detected at concentrations of concern.

Laboratory completeness is a measure of the number of usable, valid laboratory measurements per matrix obtained for each target analyte. Usable, valid results are those that are judged, after data assessment, to represent the sampling populations and to have not been disqualified for use during data validation or data assessment. The laboratory completeness criterion is 90%. Qualifications on the use of data caused by incomplete data sets will be documented in the RI report.

Percent completeness will be calculated using the following equation:

$$\% \text{ Completeness} = \frac{(\text{number of valid measurements})}{(\text{number of measurements planned})} \times 100\%$$

Because the many parameters to be measured for this project are interrelated in many different ways, a single completeness criterion cannot be established for the project. Instead, the ability to attain project objectives will be evaluated at the end of each sampling round by how effectively the necessary decisions and data evaluations can be made.

#### **A7.E Comparability Assessment**

Comparability is defined as the confidence that one data set can be compared to another (e.g., between sampling points and between sampling events). For example, background comparisons of data generated by similar sampling and analysis methods incorporate similar biases and precision and are expected to be directly comparable without any adjustments or compensations.

Comparability is achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measure), and by making certain that reporting and detection limits are sufficiently low to satisfy project detection and quantitation criteria. The reporting limits (RLs) and detection limits anticipated for this project are presented in Table A-15. Additionally, consideration was given to seasonal conditions and other environmental variations that could influence analytical results, but no such influences appear to exist for this investigation that would indicate a need to collect samples at times other than those planned. Planned analytical data will be comparable when similar sampling and analytical methods are used and documented for each sampling round. Results will be reported in units that allow comparison with previous data.

Overall data comparability depends on the proper design of the FSP and will be satisfied by using this QAPP and proper sampling techniques. The rationale behind the FSP design is found in the DQOs. Field SOPs are provided in as part of the Supplemental Field Sampling Plan in Appendix V.

#### **A7.F      Sensitivity**

Laboratory and field analytical measurement methods have been selected that measure the lowest applicable risk-based target level (RBTL) (laboratory methods) or the lowest expected field concentration (field methods), where feasible. The lowest RBTLs and corresponding laboratory method detection limits (MDLs) are presented in Table A-15. Laboratory MDLs have been determined in advance so the ability to meet the RBTL could be evaluated. In some cases, the desired concentration levels are less than the corresponding MDL and cannot be measured using conventional analytical methods. For those exceptions, there is no plan to select analytical methods than can measure lower concentrations because either the cost would be inordinate or there is no technology available to meet the limits.

### **A8            SPECIAL TRAINING REQUIREMENTS / CERTIFICATION**

Special training requirements were identified in Section A4.E. Project personnel will be qualified and experienced for the project task that they will be conducting.

### **A9            DOCUMENTATION AND RECORDS**

#### **A9.A      Log Books and Forms**

Standard forms, field notebooks, and a field log book will be used to record the sample collection activities, field measurements, observations concerning site conditions, and other project-related

information. These records include sample log sheets, daily activity records, field logbooks, drilling and well completion log sheets, and field instrument calibration log sheets, among others. More details regarding record keeping are included in SOP CTO154-10 (Appendix V).

#### **A9.A.1 Field Log Books**

Bound, weatherproof field notebooks shall be maintained by sampling personnel. The information related to sampling and other field activities will be recorded in field notebooks. This information will include, but is not limited to, sampling personnel, sampling time, weather conditions, unusual events, field measurements, and descriptions of photographs.

A bound, weatherproof logbook shall be maintained by the FOL. This book will contain a summary of each day's activities and will reference the field notebooks when applicable.

#### **A9.A.2 Drilling and Well Completion Logs**

A drilling log will be completed for every boring that occurs during these field activities. A geologist will complete the boring log, which will include information regarding date, time, personnel, drilling and sampling equipment, geologic materials encountered, fracture locations and density in bedrock (where appropriate), color, texture, odors, and readings made with the screening instruments (see SOPs CTO154-06 and CTO154-07 in Appendix V).

A well completion log will be completed for every monitoring well that is constructed. These logs will include information concerning the date, time of events, quantities of construction materials used, lengths and diameters of riser pipe and well screen placed in the well, and other information, as described in SOP CTO154-07 (Appendix V).

#### **A9.A.3 Well Development Log Sheets**

During the development or redevelopment of each monitoring well, the date, time of events, development method and equipment, personnel present, amounts of water produced, measurements made by field water quality meters, and depths to water will be recorded on a well development log sheet, as described in SOP CTO154-02 (Appendix V).

#### **A9.A.4 Equipment Calibration Logs**

An equipment calibration log sheet will be used to record each time an instrument is calibrated or recalibrated, or calibration is checked against a standard or background. Each piece of equipment has its own equipment calibration log sheet. The procedures and standards for instrument calibration are discussed in each instrument's instruction manual.

#### **A9.A.5 Sample Collection Logs**

One sample collection log sheet will be completed for every environmental sample, every duplicate sample, and every field blank sample collected during the field activities. Only the MS and MSD samples do not require their own individual sample collection log sheet.

#### **A9.A.6 Chain-of-Custody Forms**

A chain-of-custody form will be completed for every cooler of samples shipped to an off-site laboratory for analyses. These forms are a record of people maintaining custody of the samples from the time the samples are collected to the time they are analyzed and disposed of (see SOP CTO154-11 in Appendix V). The completed field chain-of-custody document will be signed, placed in a sealed plastic envelope, and taped to the top inside cover of the shipping container before it is shipped. A copy of the document will be retained by the FOL.

#### **A9.A.7 Shipping Forms/Air Bills**

Copies of forms and/or air bills related to the shipment of coolers will be retained by the FOL to trace the shipment, if necessary, and to communicate with the receiving laboratory.

### **A9.B Data reporting package format and documentation control**

#### **A9.B.1 Field Data Reporting**

Field parameters will be recorded in the site logbook and on sample logsheets as the measurements are obtained and later encoded in the NTC Great Lakes database for presentation in the report. If an error is made in the logbook, the error will be legibly crossed out (single-line strikeout), initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. No calculations will be necessary to reduce these data for inclusion in report. The records of field measurements (i.e., field logbooks, sampling logbooks, and sample logsheets) will be placed in the TtNUS central files upon completion of the field effort. To enter these results in the database will require removal of these records

from the files. Outcards (date, person, subject matter) will be used to document the removal of documentation from the files. After database entry is complete, the records will be copied for placement in the TtNUS central files.

#### **A9.B.2 Laboratory Data Reporting**

A confirmational level of analytical quality is needed to achieve the investigation objectives. This provides the highest level of data quality necessary to address potential risks. These analyses require full documentation of the chosen analytical methods and sample preparation steps, data packages, and data validation sufficient to provide defensible data. QC must be sufficient to define the overall precision and accuracy of these procedures. Therefore, data reported by STL for the analytical fractions will be in a CLP-like reporting format. Hard-copy data deliverables will be generated at the time of analysis. The pertinent QC data (including raw data and summary forms for blanks, standards analysis, calibration information, etc.), will be provided for all analyses. Case narratives will be provided for each sample delivery group (SDG). A summary of the laboratory data package elements and information that will be provided in the CLP-type packages produced by the laboratory is provided in Table A-17. Appendix IV provides further details regarding the information that will be included in CLP-type packages produced by STL.

Validation will be completed using the hard copy data. After validation, the Data Validation Manager will review the validated data, the validation qualifiers will be entered into the electronic database, and the data will be subjected to independent review for accuracy. During this review process, the electronic database printout also will be compared with the hard copy data to make sure that the hard copy data and electronic data are consistent.

**TABLE A-1**  
**PROJECT PERSONNEL**  
**NAMES, PHONE NUMBERS AND ADDRESSES**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 1 OF 2**

<b>PERSON / TITLE / ORGANIZATION</b>	<b>ADDRESS</b>	<b>TELEPHONE</b>
Owen Thompson Project Manager U.S. EPA Region 5	EPA Region 5 77 West Jackson Street Chicago, Illinois 60604	Phone: (312) 886-4843 FAX: (312) 353-8426
Brian Conrath Bureau of Land IEPA	Illinois EPA Bureau of Land 1021 N. Grand Avenue East Springfield, Illinois 62702	Phone: (217) 557-8155 FAX: (217) 782-3258
Leslie Morrow Office of Environmental Policy and Science IEPA	Illinois EPA Office of Environmental Policy and Science 1021 N. Grand Avenue East Springfield, Illinois 62702	Phone: (217) 875-5735 FAX: (217) 785-1312
Anthony Robinson Remedial Project Manager U.S. Navy SOUTHNAVFACENGCOM	Department of Navy SOUTHNAVFACENGCOM Code 18511 2155 Eagle Drive Charleston, SC 29406	Phone: (843) 820-7339 FAX: (843) 820-7465
Mark Schultz Environmental Site Manager NTC Great Lakes	NTC Great Lakes Dept. of Navy ACOS Installations & Environment Building 1A, Code N457 201 Decatur Avenue Great Lakes, IL 60088	Phone: (847) 688-5999 x 140 FAX: (847) 688-2319
Dan Fleming IR Program Manager	NTC Great Lakes Dept. of Navy ACOS Installations & Environment Building 1A, Code N457 201 Decatur Avenue Great Lakes, IL 60088	Phone: (847) 688-5999 x 161 FAX: (847) 688-2319
Debbie Wroblewski Program Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-8968 FAX: (412) 921-4040
Paul Frank Quality Assurance Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-8950 FAX: (412) 921-4040
Matt Soltis Health and Safety Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-8912 FAX: (412) 921-4040
Robert F. Davis, Jr. Task Order Manager Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-7251 FAX: (412) 921-4040



**TABLE A-1**  
**PROJECT PERSONNEL**  
**NAMES, PHONE NUMBERS AND ADDRESSES**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 2 OF 2**

<b>PERSON / TITLE / ORGANIZATION</b>	<b>ADDRESS</b>	<b>TELEPHONE</b>
Robert Balkovec Project Geologist and Field Operations Leader Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-8616 FAX: (412) 921-4040
Joseph Samchuck Data Validation Manager Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	Phone: (412) 921-8510 FAX: (412) 921-4040
Angie Scheetz Project Chemist Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-7271 FAX: (412) 921-4040
Dr. Tom Johnston Quality Assurance Advisor Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	Phone: (412) 921-8615 FAX: (412) 921-4040
Thomas Jackman Human Health Risk Assessor Tetra Tech NUS	Tetra Tech NUS 661 Andersen Drive Pittsburgh, PA 15220-2745	Phone: (412) 921-8724 FAX: (412) 921-4040
Aaron Bernhardt Ecological Risk Assessor Tetra Tech NUS	Tetra Tech NUS 661 Anderson Drive Pittsburgh, PA 15220	Phone: (412) 921-8433 FAX: (412) 921-4040
Veronica Bortot Project Manager Lab	STL- Pittsburgh 450 William Pitt Way Pittsburgh, PA 15238	Phone: (412) 820-2148 FAX: (412) 820-2080
Patrick Conlon Lab QA Manager	STL- Pittsburgh 450 William Pitt Way Pittsburgh, PA 15238	Phone: (412)820-8380 FAX: (412) 820-2080
Albert Vicinie Lab Operations Manager	STL- Pittsburgh 450 William Pitt Way Pittsburgh, PA 15238	Phone: (412)820-8380 FAX: (412) 820-2080
Anthony Lee Lab Sample Custodian	STL- Pittsburgh 450 William Pitt Way Pittsburgh, PA 15238	Phone: (412)820-2150 FAX: (412) 820-2090

TABLE A-2  
FREQUENCY OF DETECTION  
SITE 7  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2

Parameter	Units	12/1995 <sup>1</sup>	12/1988 <sup>2</sup>							IEPA Taco Exposure Route-Specific Values for Soils Ingestion <sup>3</sup>	EPA Region IX Soil Residential <sup>4</sup>
		GL-007-01 0-0.5'	BO7-1A 0-0.5'	BO7-1B 1.5-2'	BO7-2A 0-0.5'	BO7-2B 1.5-2'	BO7-3A 0-0.5'	BO7-3AX 1.5-2'	BO7-3B 0-0.5'		
INORGANICS											
ALUMINUM	mg/kg	3670	NA	NA	NA	NA	NA	NA	NA		76000
ANTIMONY	mg/kg	2	NA	NA	NA	NA	NA	NA	NA	31	31
ARSENIC	mg/kg	3.4	NA	NA	NA	NA	NA	NA	NA	0.4	0.39
BARIUM	mg/kg	55.8	NA	NA	NA	NA	NA	NA	NA	5500	5400
BERYLLIUM	mg/kg	0.27	NA	NA	NA	NA	NA	NA	NA	0.1	150
CADMIUM	mg/kg	2.5	ND	ND		1.94	1.22	1.22	ND	78	37
CALCIUM	mg/kg	85100	NA	NA	NA	NA	NA	NA	NA		
CHROMIUM	mg/kg	34.9	26.48	12.92	26.81	20.51	22.48	30.68	32.02	390	210
COBALT	mg/kg	5.7	NA	NA	NA	NA	NA	NA	NA	4700	4700
COPPER	mg/kg	229	NA	NA	NA	NA	NA	NA	NA	2900	2900
IRON	mg/kg	11600	NA	NA	NA	NA	NA	NA	NA		23000
LEAD	mg/kg	211	37.5	74.38	413.59	36.09	208.25	48.56	31.81	400	400
MAGNESIUM	mg/kg	48900	NA	NA	NA	NA	NA	NA	NA		
MANGANESE	mg/kg	332	NA	NA	NA	NA	NA	NA	NA	3700	1800
MERCURY	mg/kg	0.23	NA	NA	NA	NA	NA	NA	NA	23	
NICKEL	mg/kg	11.5	NA	NA	NA	NA	NA	NA	NA	1600	1600
POTASSIUM	mg/kg	1090	NA	NA	NA	NA	NA	NA	NA		
SELENIUM	mg/kg	1.4	NA	NA	NA	NA	NA	NA	NA	390	390
SILVER	mg/kg	0.24	ND	ND	ND	ND	ND	ND	ND	390	390
SODIUM	mg/kg	166	NA	NA	NA	NA	NA	NA	NA		
VANADIUM	mg/kg	12.6	NA	NA	NA	NA	NA	NA	NA	550	550
ZINC	mg/kg	463	NA	NA	NA	NA	NA	NA	NA	23000	23000
SEMIVOLATILE ORGANIC COMPOUNDS											
ACENAPHTHENE	ug/kg	84	NA	NA	NA	NA	NA	NA	NA	4700000	3700
ANTHRACENE	ug/kg	210	NA	NA	NA	NA	NA	NA	NA	23000000	22000
BENZO(A)ANTHRACENE	ug/kg	670	NA	NA	NA	NA	NA	NA	NA	900	0.62
BENZO(A)PYRENE	ug/kg	710	NA	NA	NA	NA	NA	NA	NA	90	0.062
BENZO(B)FLUORANTHENE	ug/kg	1800	NA	NA	NA	NA	NA	NA	NA	900	0.62
BENZO(G,H,I)PERYLENE	ug/kg	310	NA	NA	NA	NA	NA	NA	NA		56
BIS(2-ETHYLHEXYL)PHTHALATE	ug/kg	6800	NA	NA	NA	NA	NA	NA	NA	46000	35
BUTYLBENZYLPHTHALATE	ug/kg	160	NA	NA	NA	NA	NA	NA	NA	16000000	12000
CARBAZOLE	ug/kg	140	NA	NA	NA	NA	NA	NA	NA	32000	24
CHRYSENE	ug/kg	930	NA	NA	NA	NA	NA	NA	NA	88000	62
DI-N-OCTYLPHTHALATE	ug/kg	310	NA	NA	NA	NA	NA	NA	NA	1600000	1200
DIBENZ(A,H)ANTHRACENE	ug/kg	170	NA	NA	NA	NA	NA	NA	NA	90	0.062

**TABLE A-2**  
**FREQUENCY OF DETECTION**  
**SITE 7**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 2 OF 2**

Parameter	Units	12/1995 <sup>1</sup>	12/1988 <sup>2</sup>							IEPA Taco Exposure Route-Specific Values for Soils Ingestion <sup>3</sup>	EPA Region IX Soil Residential <sup>4</sup>
		GL-007-01 0-0.5'	BO7-1A 0-0.5'	BO7-1B 1.5-2'	BO7-2A 0-0.5'	BO7-2B 1.5-2'	BO7-3A 0-0.5'	BO7-3AX 1.5-2'	BO7-3B 0-0.5'		
FLUORANTHENE	ug/kg	1600	NA	NA	NA	NA	NA	NA	NA	3100000	2300
FLUORENE	ug/kg	96	NA	NA	NA	NA	NA	NA	NA	3100000	2600
INDENO(1,2,3-CD)PYRENE	ug/kg	330	NA	NA	NA	NA	NA	NA	NA	900	0.62
PHENANTHRENE	ug/kg	1200	NA	NA	NA	NA	NA	NA	NA		56
PHENOL	ug/kg		NA	NA	NA	NA	NA	NA	NA	47000000	37000
PYRENE	ug/kg	1400	NA	NA	NA	NA	NA	NA	NA	2300000	2300
<b>VOLATILE ORGANIC COMPOUNDS</b>											
ACETONE	ug/kg	6	40	53	27	21	13	54	29	7800000	1600
CHLOROFORM	ug/kg	2	ND	ND	ND	ND	ND	ND	ND	100000	0.24
METHYLENE CHLORIDE	ug/kg	NA	55	43	25	15	13	19	13	85000	8.9
HEXANE	ug/kg	NA	ND	10	ND	8	9	ND	8		
TETRACHLOROETHENE	ug/kg	28	ND	ND	ND	ND	ND	ND	ND	12000	5.7
TOLUENE	ug/kg	NA	30	20	15	24	26	22	30	16000000	520
<b>PESTICIDES / PCBS</b>											
4,4'-DDD	ug/kg	3.4	NA	NA	NA	NA	NA	NA	NA	3000	2.4
4,4'-DDE	ug/kg	20	NA	NA	NA	NA	NA	NA	NA	2000	1.7
4,4'-DDT	ug/kg	51	NA	NA	NA	NA	NA	NA	NA	2000	1.7
ALPHA-CHLORDANE	ug/kg	4.4	NA	NA	NA	NA	NA	NA	NA	500	1.6
AROCLOR-1242	ug/kg	76	NA	NA	NA	NA	NA	NA	NA		0.22
AROCLOR-1254	ug/kg	190	NA	NA	NA	NA	NA	NA	NA		0.22
DIELDRIN	ug/kg	3.8	NA	NA	NA	NA	NA	NA	NA	40	0.03
ENDOSULFAN I	ug/kg	11	NA	NA	NA	NA	NA	NA	NA	470000	370
ENDOSULFAN II	ug/kg	2.3	NA	NA	NA	NA	NA	NA	NA	470000	370
ENDOSULFAN SULFATE	ug/kg	5.5	NA	NA	NA	NA	NA	NA	NA		370
ENDRIN	ug/kg	8.3	NA	NA	NA	NA	NA	NA	NA	23000	18
ENDRIN KETONE	ug/kg	3.3	NA	NA	NA	NA	NA	NA	NA		18
GAMMA-CHLORDANE	ug/kg	1.9	NA	NA	NA	NA	NA	NA	NA	500	1.6
HEPTACHLOR	ug/kg	1.3	NA	NA	NA	NA	NA	NA	NA	100	0.11
HEPTACHLOR EPOXIDE	ug/kg	1.6	NA	NA	NA	NA	NA	NA	NA	70	0.053

NA - not analyzed

ND - not detected

<sup>1</sup> Technical Memorandum for Support of the Relative Risk Evaluation at Various Activities, (Brown & Root Environmental, 1996)<sup>2</sup> Technical Memorandum on the Remedial Investigation Verification Step, (Dames & Moore, 1991)<sup>3</sup> TACO (IEPA, 1996)<sup>4</sup> PRGs (U.S. EPA, 2000b)

Note: Shaded results exceed TACO Residential Criteria. U.S. EPA Region IX PRGs are provided for reference.

**TABLE A-3**  
**OFFSITE SEDIMENT**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 1 OF 3**

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region 9 Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
<b>INORGANICS</b>										
ALUMINUM	12/12	4000	16200	9004	X117-91			76000	50	
ANTIMONY	3/12	10.4	60.4	12.7	X118-91	31		31	3	
ARSENIC	12/12	5.8	28.2	12.5	X117-91	0.4	750	0.39	10	8
BARIUM	12/12	40	387	131	X117-91	5500	690000	5400	160	145
BERYLLIUM	12/12	0.5	53.8	10.2	X117-91	0.1	1300	150	1.1	
CADMIUM	10/12	1.5	51.6	9.4	X117-91	78	1800	37	0.8	0.5
CHROMIUM	12/12	17	380	71.1	X117-91	390	270	30	0.4	16
COBALT	12/12	4	39	12.5	X117-91	4700		4700	9	
COPPER	12/12	69.8	61700	9084	X117-91	2900		2900	36	38
CYANIDE	3/12	1.5	11.4	3.1	X112-91	1600		11	0.9	
IRON	12/12	9044	60600	26379	X117-91			23000	200	18000
LEAD	12/12	46.9	13200	2723	X117-91	400		400	50	28
MAGNESIUM	12/12	5900	47200	30575	X111-91					
MANGANESE	12/12	291	2760	915	X117-91	3700	69000	1800	100	1300
MERCURY	11/12	0.14	35.9	3.9	X118-91	23	10		0.3	0.07
NICKEL	11/12	19.4	1070	181	X117-91	1600	13000	1600	30	26
POTASSIUM	11/12	549	4700	1443	X209-94					1500
SELENIUM	6/12	0.56	8.4	2.2	X117-91	390		390	0.7	
SILVER	6/12	1.9	37.4	14.6	X117-91	390		390	2	5
THALLIUM	3/12	0.24	0.49	2.2	X209-94	6.3		5.2	1	
VANADIUM	12/12	7.6	29.7	16.5	X209-94	550		550	2	
ZINC	12/12	614	100500	18055	X117-91	23000		23000	50	80
<b>SEMIVOLATILE ORGANIC COMPOUNDS</b>										
1,2-DICHLOROBENZENE	1/14	0.41	0.41	0.41	X118-91			370	0.03	0.34
2-METHYLNAPHTHALENE	4/14	0.093	0.32	0.22	X115-91	3100				0.368
4-METHYLPHENOL	1/14	0.82	0.82	0.82	X207-94			310		
ACENAPHTHENE	4/14	0.076	1.5	0.80	X112-91	4700		3700	20	0.585
ANTHRACENE	6/14	0.13	2	0.81	X112-91	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	5/14	0.35	2.7	1.2	X207-94	0.9		0.62	0.1	0.287

**TABLE A-3**  
**OFFSITE SEDIMENT**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 2 OF 3**

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region 9 Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
BENZO(A)PYRENE	8/14	0.27	4.4	1.8	X112-91	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	7/14	0.29	4.8	2.1	X112-91	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	4/14	0.46	3.4	2.0	X112-91	3100		56	0.1	0.17
BENZO(K)FLUORANTHENE	7/14	0.34	3.5	1.5	X112-91	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	6/14	0.44	22	4.7	X207-94	46	31000	35	0.017	
BUTYL BENZYL PHTHALATE	1/14	0.21	0.21	0.21	X112-91	16000	930	12000	0.017	11
CARBAZOLE	2/9	0.11	0.83	0.47	63-SD-PC-	32		24		
CHRYSENE	9/14	0.38	4.7	1.9	X112-91	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/14	1.1	1.1	1.1	X207-94	7800	2300	6100	200	11
DI-N-OCTYL PHTHALATE	1/14	0.32	0.32	0.32	X111-91	1600	10000	1200	0.017	
DIBENZO(A,H)ANTHRACENE	1/14	0.37	0.37	0.37	63-SD-PC-	0.09		0.062		0.06
DIBENZOFURAN	3/14	0.47	0.96	0.70	X112-91			290		2
FLUORANTHENE	10/14	0.25	11	3.8	X112-91	3100		2300	0.1	2.79
FLUORENE	4/14	0.088	1.4	0.77	X112-91	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	6/14	0.15	3.6	1.2	X112-91	0.9		0.62	0.1	2.5
ISOPHORONE	1/14	0.086	0.086	0.086	63-SD-PC-	15600	4600	510		
NAPHTHALENE	3/14	0.27	0.63	0.48	X112-91	3100		56	0.1	0.34
PHENANTHRENE	11/14	0.13	10	3.1	X112-91	3100		56	0.1	0.81
PHENOL	2/14	0.084	0.12	0.10	63-SD-PC-	47000		37000	0.05	
PYRENE	10/14	0.25	6.8	2.7	X115-91			2300		0.35
<b>VOLATILE ORGANIC COMPOUNDS</b>										
1,1,1-TRICHLOROETHANE	2/14	0.008	0.019	0.014	X111-91		1200	630	0.07	0.17
1,1,2,2-TETRACHLOROETHANE	1/14	0.004	0.004	0.004	X207-94			0.38		0.94
1,1-DICHLOROETHANE	2/14	0.005	0.012	0.0085	X210-94	7800	1300	590	0.02	
1,1-DICHLOROETHENE	1/14	0.008	0.008	0.008	X210-94			0.054	0.1	
2-BUTANONE	2/14	0.016	0.031	0.013	X207-94			7300		
4-METHYL-2-PENTANONE	1/14	0.003	0.003	0.003	X207-94			790		
ACETONE	4/14	0.005	0.046	0.016	X207-94	7800	100000	1600		
BENZENE	1/14	0.004	0.004	0.004	63-SD-PC-	22	0.8	0.65	0.01	0.006
CARBON DISULFIDE	2/14	0.004	0.005	0.005	63-SD-PC-	7800	720	360		

**TABLE A-3**  
**OFFSITE SEDIMENT**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 3 OF 3**

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region 9 Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
ETHYLBENZENE	1/14	0.006	0.006	0.006	X207-94	7800	400	230	0.03	0.028
METHYLENE CHLORIDE	4/14	0.011	0.016	0.014	X115-91 X117-91	85	13	8.9		
STYRENE	1/14	0.003	0.003	0.003	X207-94			1700	0.3	
TETRACHLOROETHENE	4/14	0.002	0.059	0.023	X118-91	12	11	5.7	0.002	0.53
TOLUENE	2/14	0.008	0.012	0.01	X207-94	16000	650	520	0.01	0.11
TOTAL 1,2-DICHLOROETHENE	8/14	0.004	0.7	0.12	X210-94	16000	650	520	0.01	0.11
TOTAL XYLENES	2/14	0.007	0.033	0.02	X207-94	16000	650	520	0.01	0.11
TRICHLOROETHENE	9/14	0.004	0.015	0.0091	63-SD-PC	58	5	2.8	0.1	1.6
VINYL CHLORIDE	4/14	0.03	0.67	0.21	X210-94	0.3	0.03	0.15	0.01	
<b>PESTICIDES / PCBS</b>										
4,4'-DDD	3/14	0.0057	0.053	0.022	X207-94	3		2.4	0.0033	0.008
4,4'-DDE	2/14	0.016	0.022	0.019	63-SD-PC-1	2		1.7	0.0033	0.005
4,4'-DDT	4/14	0.00053	0.069	0.020	X207-94	2		1.7	0.0033	0.007
ALPHA-CHLORDANE	3/14	0.0024	0.012	0.031	X207-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1016	2/14	0.012	0.083	0.065	X117-91	1		3.9	0.0029	0.007
AROCLOR-1254	9/14	0.069	12	2.0	X118-91	1		0.22	0.0029	0.06
AROCLOR-1260	3/14	0.01	0.46	0.17	X207-94	1		0.22	0.0029	0.005
DIELDRIN	2/14	0.00059	0.0058	0.0088	X207-94	0.04	1	0.03	0.0005	0.052
ENDOSULFAN II	1/14	0.017	0.017	0.019	X207-94	470		370	0.00001	0.014
ENDOSULFAN SULFATE	1/14	0.009	0.009	0.015	63-SD-PC-1	470		370	0.00001	0.0054
ENDRIN	5/14	0.00044	0.26	0.064	X118-91	23		18	0.00004	0.02
ENDRIN ALDEHYDE	2/9	0.00022	0.0061	0.0032	X210-94	23		18		0.02
GAMMA-CHLORDANE	2/14	0.0017	0.0085	0.037	X207-94	0.05	20	1.6	0.00003	0.007
HEPTACHLOR EPOXIDE	1/14	0.0062	0.0062	0.0081	63-SD-PC-1	0.07	5	0.053	0.0000002	0.005

Note: Shaded values are screening values that are less than the maximum concentration.

IEPA = Illinois Environmental Protection Agency

TACO = Tiered Approach to Corrective Action Objectives

**TABLE A-4**  
**OFFSITE SURFACE WATER**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
<b>INORGANICS</b>													
ALUMINUM	7/13	68	539	235	GL63-SW-PC-11		36000						87
ARSENIC	6/6	1	3.1	1.9	GL63-SW-PC-11	50	0.045	50	0.018			50	148
BARIUM	13/13	37	117	69.1	C-3	2000	2600	2000	1000			1000	5000
BORON	7/7	444	699	611	C-2-F		3300						
CALCIUM	12/13	69	126000	52775	GL63-SW-PC-11-F								
CALCIUM	12/13	69	126000	52775	GL63-SW-PC-11-F-D								
CHROMIUM	3/13	6	7	6.3	C-3	100	110	100					11
COPPER	9/13	5	100	28.2	GL63-SW-PC-11	650	1400	1300	1000				8.96
CYANIDE	1/7	12	12	12	GL63-SW-PC-10	200	6.2	200					5.2
IRON	7/13	72	10010	2786	C-3	5000	11000		300			300	1000
LEAD	2/13	36.8	37	36.9	GL63-SW-PC-11-D	7.5	15	15				50	5.08
MAGNESIUM	13/13	32	45400	17737	GL63-SW-PC-11-F								
MAGNESIUM	13/13	32	45400	17737	GL63-SW-PC-11-F-D								
MANGANESE	13/13	82	2031	409	C-3	150	880		50				1000
NICKEL	4/13	11	33	19.8	C-3	100	730		610				52.01
POTASSIUM	13/13	2.4	8530	3778	GL63-SW-PC-11-F-D								
SODIUM	13/13	33	58700	24459	GL63-SW-PC-10								
STRONTIUM	7/7	223	564	333	C-3		22000						
ZINC	9/13	101	502	206	GL63-SW-PC-11	5000	11000		5000				118
<b>MISCELLANEOUS</b>													
AMMONIA	4/4	0.06	1.5	0.565	C-3		210						
<b>SEMIVOLATILE ORGANIC COMPOUNDS</b>													
BIS(2-ETHYLHEXYL)PHTHALATE	2/3	2	3	2.5	GL63-SW-PC-11	6	4.8	6	1.8				3
ISOPHORONE	2/3	31	41	36	GL63-SW-PC-11	1400	71		36				
<b>VOLATILE ORGANIC COMPOUNDS</b>													
1,1-DICHLOROETHANE	2/3	8	10	9	GL63-SW-PC-11-D	700	810						47
METHYLENE CHLORIDE	2/3	56	60	58	GL63-SW-PC-11-D	5	4.3	5	4.7	2600		340	1380
TOTAL 1,2-DICHLOROETHENE	3/3	8	80	52.3	GL63-SW-PC-11-D	1000	720	1000	6800	51000	5600		110
TRICHLOROETHENE	3/3	8	72	48.7	GL63-SW-PC-11	5	1.6	5	2.7	370	29		940
VINYL CHLORIDE	2/3	6	9	7.5	GL63-SW-PC-11-D	2	0.041	2	2				

Note: Shaded values are screening values that are less than the maximum concentration.

MCL = Maximum Concentration Limit

AWQC = Ambient Water Quality Criteria

TABLE A-5

PETTIBONE CREEK SEDIMENT  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
<b>INORGANICS</b>										
ALUMINUM	6/7	2810	5300	4220	X113-91			76000	50	
ARSENIC	9/10	5.3	27.1	11.2	GL63-SD-PC-07	0.4	750	0.39	10	8
BARIUM	7/8	23.3	95	53.4	X113-91	5500	690000	5400	160	145
BERYLLIUM	6/7	0.46	1.5	0.8	GL63-SD-PC-09	0.1	1300	150	1.1	
CADMIUM	6/10	0.89	3	2.0	SITE 4	78	1800	37	0.8	0.5
CALCIUM	6/7	47800	70800	58433	GL63-SD-PC-07					
CHROMIUM	9/10	5.9	47	24.6	SITE 4	390	270	30	0.4	16
COBALT	4/7	5	7.3	6.3	X113-91	4700		4700	9	
COPPER	9/10	38.2	1030	291	GL63-SD-PC-09	2900		2900	36	38
CYANIDE	2/7	2.4	3.6	2.1	GL63-SD-PC-09	1600		11	0.9	
IRON	7/8	11600	25000	16914	C-4-SED			23000	200	18000
LEAD	9/10	40.2	392	196	GL63-SD-PC-09	400		400	50	28
MAGNESIUM	6/7	23700	40200	30633	X113-91					
MANGANESE	7/8	345	590	437	C-4-SED	3700	69000	1800	100	1300
MERCURY	7/10	0.04	1.2	0.35	GL63-SD-PC-09	23	10		0.3	0.07
NICKEL	7/8	9.2	45.1	24.7	GL63-SD-PC-09	1600	13000	1600	30	26
POTASSIUM	7/8	684	2600	1148	C-4-SED					1500
SILVER	3/8	1.8	3.8	2.8	GL63-SD-PC-09	390		390	2	5
SODIUM	5/7	238	354	284	GL63-SD-PC-07					
VANADIUM	6/7	7.6	15.6	12.9	X113-91	550		550	2	
ZINC	9/10	159	2730	890	GL63-SD-PC-09	23000		23000	50	80
<b>SEMIVOLATILE ORGANIC COMPOUNDS</b>										
2-METHYLNAPHTHALENE	1/7	0.085	0.085	0.085	GL63-SD-PC-09	3100				0.368
ACENAPHTHENE	2/7	0.16	0.5	0.33	GL63-SD-PC-09	4700		3700	20	0.585
ANTHRACENE	4/7	0.075	0.91	0.54	GL63-SD-PC-09	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	5/7	0.26	2.8	1.7	X206-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	5/7	0.19	2.2	0.96	X206-94	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	4/7	0.21	4.3	1.9	X206-94	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	1/7	0.58	0.58	0.58	GL63-SD-PC-09	3100		56	0.1	0.17
BENZO(K)FLUORANTHENE	5/7	0.17	2.3	1.0	X201-94	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	6/9	0.01	300	52.4	X201-94	46	31000	35	0.017	
BUTYL BENZYL PHTHALATE	2/7	0.085	0.42	0.25	X201-94	16000	930	12000	0.017	11



TABLE A-5

PETTIBONE CREEK SEDIMENT  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
CHRYSENE	6/7	0.19	3.5	1.6	X206-94	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/7	0.74	0.74	0.74	X201-94	7800	2300	6100	200	11
DI-N-OCTYL PHTHALATE	1/7	23	23	23	X201-94	1600	10000	1200	0.017	
DIBENZOFURAN	3/7	0.12	0.51	0.31	X201-94			290		2
FLUORANTHENE	6/7	0.37	7.2	3.1	X206-94	3100		2300	0.1	2.79
FLUORENE	3/7	0.22	0.68	0.47	X201-94	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	2/7	0.22	0.52	0.37	GL63-SD-PC-09	0.9		0.62	0.1	2.5
NAPHTHALENE	1/7	0.17	0.17	0.17	GL63-SD-PC-09	3100		56	0.1	0.34
PHENANTHRENE	5/7	0.31	4.8	3.2	X206-94 GL63-SD-PC-09	3100		56	0.1	0.81
PYRENE	6/7	0.41	6.1	2.8	X206-94			2300		0.35
<b>VOLATILE ORGANIC COMPOUNDS</b>										
ACETONE	1/7	0.8	0.8	0.40	GL63-SD-PC-08	7800	100000	1600		
METHYLENE CHLORIDE	1/7	0.016	0.016	0.016	X113-91	85	13	8.9		
<b>PESTICIDES / PCBS</b>										
4,4'-DDD	6/10	0.026	0.46	0.20	X206-94	3		2.4	0.0033	0.008
4,4'-DDE	6/10	0.048	0.41	0.22	SITE 3	2		1.7	0.0033	0.005
4,4'-DDT	6/10	0.034	1	0.24	SITE 3	2		1.7	0.0033	0.007
ALPHA-BHC	1/8	0.006	0.006	0.006	X206-94	0.1	0.8	0.09	0.003	0.006
ALPHA-CHLORDANE	3/8	0.0011	0.016	0.0083	X206-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1016	1/7	0.68	0.68	0.68	X206-94	1		3.9	0.0029	0.007
AROCLOR-1254	3/9	0.27	1.9	0.89	X206-94	1		0.22	0.0029	0.06
AROCLOR-1260	2/7	0.31	2.3	1.3	X206-94	1		0.22	0.0029	0.005
DIELDRIN	2/8	0.0048	0.052	0.028	X206-94	0.04	1	0.03	0.0005	0.052
ENDOSULFAN I	1/7	0.011	0.011	0.011	X206-94	470		370	0.00001	0.0029
ENDOSULFAN II	1/7	0.012	0.012	0.012	X201-94	470		370	0.00001	0.014
ENDRIN	2/8	0.033	0.19	0.11	X206-94	23		18	0.00004	0.02
GAMMA-BHC (LINDANE)	1/8	0.049	0.049	0.049	SITE 4	0.5		0.44	0.00005	0.003
HEPTACHLOR	3/10	0.0013	0.082	0.052	SITE 3	0.1	0.1	0.11	0.0007	0.005

Note: Shaded values are screening values that are less than the maximum concentration.

IEPA = Illinois Environmental Protection Agency

TACO = Tiered Approach to Corrective Action Objectives

**TABLE A-6**  
**PETTIBONE CREEK SURFACE WATER**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
<b>INORGANICS</b>													
ALUMINUM	6/10	61	565	191	GL63-SW-PC-08		36000						87
BARIUM	10/10	38	74	52.9	D-2	2000	2600	2000	1000			1000	5000
BORON	4/4	840	967	897	D-2		3300						
CADMIUM	1/10	6	6	6	GL63-SW-PC-09	5	18	5					2.24
CALCIUM	10/10	94	81000	45655	GL63-SW-PC-07								
CHROMIUM	4/8	7	11	9	C-4-F	100	110	100					11
COPPER	6/10	7	16	10	GL63-SW-PC-09	650	1400	1300	1000				8.96
IRON	5/10	176	699	350	GL63-SW-PC-08	5000	11000		300			300	1000
MAGNESIUM	10/10	38	31500	17569	GL63-SW-PC-07								
MANGANESE	10/10	28	106	59.9	D-2	150	880		50				1000
MERCURY	1/8	0.16	0.16	0.16	C-4	2		2	0.05			150	0.0013
NICKEL	3/10	7	9	8	D-2	100	730		610				52.01
POTASSIUM	10/10	3.6	5230	2942	GL63-SW-PC-08								
SODIUM	10/10	108	73000	39311	GL63-SW-PC-07								
STRONTIUM	4/4	372	385	378	D-2								
ZINC	5/5	19	84	49.2	GL63-SW-PC-09	5000	11000		5000				118
ARSENIC	5/5	1	2.5	1.6	GL63-SW-PC-08	50	0.045	50	0.018		190	50	148
<b>MISCELLANEOUS</b>													
AMMONIA	2/2	0.11	0.17	0.14	C-4		210						
CHEMICAL OXYGEN DEMAND	2/2	18	37	27.5	C-4								
HARDNESS	2/2	397	572	484.5	D-2								
NITRITE/NITRATE	2/2	1.3	2	1.7	D-2	10000	1000		10000				
PHENOLS	2/2	4	13	8.5	D-2							1	
PHOSPHORUS (ELEMENTAL)	4/4	0.02	0.14	0.085	C-4		0.73					7	
PHOSPHORUS (ELEMENTAL)	4/4	0.02	0.14	0.085	C-4-F		0.73					7	
TOTAL SUSPENDED SOLIDS	2/2	4	8	6	D-2								

Note: Shaded values are screening values that are less than the maximum concentration.

MCL = Maximum Concentration Limit

AWQC = Ambient Water Quality Criteria

TABLE A-7  
SOUTH BRANCH PETTIBONE CREEK SEDIMENT  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
<b>INORGANICS</b>										
ALUMINUM	6/6	3600	10800	5910	GL63-SD-PC-05			76000	50	
ARSENIC	6/6	4.8	23.9	11.3	GL63-SD-PC-06	0.4	750	0.39	10	8
BARIUM	5/6	26.6	55.2	39.2	X202-94	5500	690000	5400	160	145
BERYLLIUM	4/6	0.3	26.8	7.1	GL63-SD-PC-04	0.1	1300	150	1.1	
CADMIUM	2/6	1.2	1.4	1.0	GL63-SD-PC-05	78	1800	37	0.8	0.5
CALCIUM	6/6	31400	80700	56550	GL63-SD-PC-06					
CHROMIUM	6/6	9.6	21	14.6	GL63-SD-PC-05	390	270	30	0.4	16
COBALT	6/6	4.8	10.5	7.8	GL63-SD-PC-05	4700		4700	9	
COPPER	6/6	14.2	23.2	19.3	GL63-SD-PC-05	2900		2900	36	38
IRON	6/6	10800	19700	15450	GL63-SD-PC-05			23000	200	18000
LEAD	6/6	19.8	48	32.2	X202-94	400		400	50	28
MAGNESIUM	6/6	16300	41100	29516.7	GL63-SD-PC-06					
MANGANESE	6/6	367	573	457.3	GL63-SD-PC-06	3700	69000	1800	100	1300
MERCURY	3/6	0.09	0.28	0.1	X114-91	23	10		0.3	0.07
NICKEL	5/6	10.4	25.3	18.5	GL63-SD-PC-05	1600	13000	1600	30	26
POTASSIUM	6/6	630	3290	1587	GL63-SD-PC-05					1500
SILVER	1/6	1.6	1.6	1.6	GL63-SD-PC-03	390		390	2	5
SODIUM	5/6	141	262	201.2	GL63-SD-PC-05					
THALLIUM	1/6	0.53	0.53	0.37	GL63-SD-PC-05	6.3		5.2	1	
VANADIUM	6/6	10.7	24.1	17.1	GL63-SD-PC-05	550		550	2	
ZINC	6/6	55.6	83.3	71.2	X202-94	23000		23000	50	80
<b>SEMIVOLATILE ORGANIC COMPOUNDS</b>										
2-METHYLNAPHTHALENE	1/6	0.16	0.16	0.16	X202-94	3100				0.368
ACENAPHTHYLENE	1/6	0.12	0.12	0.12	X202-94	4700		3700		0.186
ANTHRACENE	1/6	0.22	0.22	0.22	X202-94	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	3/6	0.1	0.88	0.39	X202-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	1/6	0.14	0.14	0.14	GL63-SD-PC-04	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	2/6	0.11	0.73	0.42	X202-94	0.9		0.62		0.886
BENZO(K)FLUORANTHENE	2/6	0.18	0.18	0.18	GL63-SD-PC-03 GL63-SD-PC-04	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	3/6	0.094	0.56	0.25	X202-94	46	31000	35	0.017	
CHRYSENE	3/6	0.13	0.87	0.41	X202-94	88		62	0.1	0.4

**TABLE A-7**  
**SOUTH BRANCH PETTIBONE CREEK SEDIMENT**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 2 OF 2**

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
DI-N-BUTYL PHTHALATE	1/6	0.96	0.96	0.96	X202-94	7800	2300	6100	200	11
DIBENZOFURAN	1/6	0.13	0.13	0.13	X202-94			290		2
FLUORANTHENE	4/6	0.18	1.6	0.64	X202-94	3100		2300	0.1	2.79
FLUORENE	1/6	0.22	0.22	0.22	X202-94	3100		2600	30	0.035
NAPHTHALENE	1/6	0.17	0.17	0.17	X202-94	3100		56	0.1	0.34
PHENANTHRENE	4/6	0.085	1.1	0.43	X202-94	3100		56	0.1	0.81
PYRENE	4/6	0.16	1.4	0.56	X202-94			2300		0.35
<b>VOLATILE ORGANIC COMPOUNDS</b>										
2-BUTANONE	1/6	0.005	0.005	0.0055	X202-94			7300		
ACETONE	2/6	0.006	0.012	0.009	X202-94	7800	100000	1600		
BROMOMETHANE	1/6	0.011	0.011	0.011	GL63-SD-PC-03	110	10	3.9		
METHYLENE CHLORIDE	1/6	0.01	0.01	0.01	X114-91	85	13	8.9		
TOLUENE	1/6	0.049	0.049	0.049	GL63-SD-PC-05	16000	650	520	0.01	0.11
<b>PESTICIDES / PCBS</b>										
4,4'-DDD	3/6	0.015	0.059	0.031	X202-94	3		2.4	0.0033	0.008
4,4'-DDE	3/6	0.0088	0.041	0.020	X202-94	2		1.7	0.0033	0.005
4,4'-DDT	3/6	0.0079	0.071	0.030	X202-94	2		1.7	0.0033	0.007
ALPHA-BHC	1/6	0.0012	0.0012	0.0012	X202-94	0.1	0.8	0.09	0.003	0.006
ALPHA-CHLORDANE	1/6	0.029	0.029	0.029	X202-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1260	1/6	0.16	0.16	0.16	X202-94	1		0.22	0.0029	0.005
DIELDRIN	1/6	0.0098	0.0098	0.0098	X202-94	0.04	1	0.03	0.0005	0.052
ENDRIN	1/6	0.0097	0.0097	0.0097	X202-94	23		18	0.00004	0.02
GAMMA-CHLORDANE	1/6	0.016	0.016	0.016	X202-94	0.05	20	1.6	0.00003	0.007
HEPTACHLOR EPOXIDE	1/6	0.004	0.004	0.004	X202-94	0.07	5	0.053	0.0000002	0.005

Note: Shaded values are screening values that are less than the maximum concentration.

IEPA = Illinois Environmental Protection Agency

TACO = Tiered Approach to Corrective Action Objectives

**TABLE A-8**  
**SOUTH BRANCH PETTIBONE CREEK SURFACE WATER**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
<b>INORGANICS</b>													
ALUMINUM	6/10	115	2050	769	GL63-SW-PC-04		36000						87
ARSENIC	7/8	1.3	3.3	2.2	GL63-SW-PC-05	50	0.045	0.018	0.018			50	148
BORON	1/2	53	53	53	D-1-F		3300						
BARIUM	10/10	28	70	49.4	GL63-SW-PC-05-F	2000	2600	1000	1000			1000	5000
BARIUM	10/10	28	70	49.4	GL63-SW-PC-05-F		2600	1000	1000			1000	5000
CALCIUM	10/10	94	86300	46929	GL63-SW-PC-05-F								
CHROMIUM	2/9	10	15	12.5	D-1	100	110						11
COPPER	5/10	3	17	9	GL63-SW-PC-04	650	1400	1000	1000				8.96
IRON	5/10	238	2880	1490.6	GL63-SW-PC-04	5000	11000	300	300			300	1000
LEAD	8	6.9	15.4	7.2	GL63-SW-PC-03	7.5	15					50	5.08
MAGNESIUM	10/10	44	38700	19139	GL63-SW-PC-05-F								
MANGANESE	10/10	18	230	80.6	GL63-SW-PC-05	150	880	50	50				1000
POTASSIUM	10/10	2.6	4530	3277	GL63-SW-PC-04								
SODIUM	10/10	104	91800	42421	GL63-SW-PC-05-F								
STRONTIUM	2/2	325	334	330	D-1		22000						
ZINC	6/10	8	63	25.3	GL63-SW-PC-04	5000	1400		5000				118
<b>MISCELLANEOUS</b>													
NITRITE/NITRATE	1/1	0.6	0.6	0.6	D-1	10000	1000		10000				
<b>VOLATILE ORGANIC COMPOUNDS</b>													
CARBON DISULFIDE	1/4	12	12	12	GL63-SW-PC-05	700	1000						0.92

Note: Shaded values are screening values that are less than the maximum concentration.

MCL = Maximum Concentration Limit

AWQC = Ambient Water Quality Criteria

TABLE A-9

**PETTIBONE CREEK BELOW CONFLUENCE SEDIMENT  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2**

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
<b>INORGANICS</b>										
ALUMINUM	5/7	2570	12400	7112	X205-94			76000	50	
ANTIMONY	1/7	15.5	15.5	11.2	X204-94	31		31	3	
ARSENIC	5/7	4.4	24	12.7	X205-94	0.4	750	0.39	10	8
BARIUM	5/7	27.3	208	94.8	X204-94	5500	690000	5400	160	145
BERYLLIUM	4/7	0.51	3	1.7	X205-94	0.1	1300	150	1.1	
CADMIUM	3/7	2.8	5.6	4.4	X205-94	78	1800	37	0.8	0.5
CHROMIUM	5/7	9.5	69.2	33.4	X205-94	390	270	30	0.4	16
COBALT	3/7	6.6	18.1	13.4	X204-94	4700		4700	9	
COPPER	5/7	38	475	217.3	X205-94	2900		2900	36	38
CYANIDE	2/7	3.9	4.2	4.1	X205-94	1600		11	0.9	
IRON	5/7	11100	19000	15000	X204-94			23000	200	18000
LEAD	5/7	40.5	435	192.2	X205-94	400		400	50	28
MAGNESIUM	5/7	22400	34200	27340	GL63-SD-PC-02					
MANGANESE	5/7	343	2470	1169.2	X205-94	3700	69000	1800	100	1300
MERCURY	3/7	0.15	1.6	1.1	X205-94	23	10		0.3	0.07
NICKEL	5/7	10	445	141.4	X205-94	1600	13000	1600	30	26
POTASSIUM	5/7	652	3350	1829.8	X204-94					1500
SELENIUM	2/7	3.5	5	1.8	X205-94	390		390	0.7	
SILVER	3/7	2	50.8	31.63333	X205-94	390		390	2	5
VANADIUM	5/7	10.5	26.9	18.0	X205-94	550		550	2	
ZINC	5/7	190	1160	490.2	X204-94	23000		23000	50	80
<b>SEMIVOLATILE ORGANIC COMPOUNDS</b>										
ACENAPHTHENE	1/7	0.13	0.13	0.13	GL63-SD-PC-02	4700		3700	20	0.585
ANTHRACENE	2/7	0.12	0.41	0.27	GL63-SD-PC-02	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	4/7	0.15	1.7	0.69	X204-94	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	3/7	0.13	0.32	0.22	GL63-SD-PC-02	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	2/7	0.19	0.35	0.27	GL63-SD-PC-02	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	1/7	0.25	0.25	0.25	GL63-SD-PC-02	3100		56	0.1	0.17
BENZO(K)FLUORANTHENE	3/7	0.27	0.39	0.32	GL63-SD-PC-02	9		6.2	0.1	8.86
CARBAZOLE	1/7	0.18	0.18	0.18	GL63-SD-PC-02	32		24		
CHRYSENE	3/7	0.19	0.59	0.38	GL63-SD-PC-02	88		62	0.1	0.4

TABLE A-9  
 PETTIBONE CREEK BELOW CONFLUENCE SEDIMENT  
 FREQUENCY OF DETECTION  
 SITE 17  
 NTC GREAT LAKES, ILLINOIS  
 PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
DI-N-BUTYL PHTHALATE	1/7	1.1	1.1	1.1	X204-94	7800	2300	6100	200	11
DIBENZOFURAN	1/7	0.14	0.14	0.14	GL63-SD-PC-02-1			290		2
FLUORANTHENE	4/7	0.31	3	1.3	X204-94	3100		2300	0.1	2.79
FLUORENE	1/7	0.25	0.25	0.25	GL63-SD-PC-02-1	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	1/7	0.22	0.22	0.22	GL63-SD-PC-02-1	0.9		0.62	0.1	2.5
PHENANTHRENE	4/7	0.2	3.1	1.4	X204-94	3100		56	0.1	0.81
PYRENE	4/7	0.3	2.4	1.1	X204-94			2300		0.35
<b>VOLATILE ORGANIC COMPOUNDS</b>										
2-BUTANONE	2/7	0.006	0.007	0.0065	X204-94			7300		
ACETONE	2/7	0.016	0.024	0.013	X205-94	7800	100000	1600		
CARBON DISULFIDE	1/7	0.004	0.004	0.004	X205-94	7800	720	360		
<b>PESTICIDES / PCBS</b>										
4,4'-DDD	5/7	0.042	3.3	1.31	X204-94	3		2.4	0.0033	0.008
4,4'-DDE	5/7	0.05	0.29	0.14	X205-94	2		1.7	0.0033	0.005
4,4'-DDT	5/7	0.038	0.26	0.12	X205-94	2		1.7	0.0033	0.007
ALPHA-CHLORDANE	1/7	0.084	0.084	0.084	X204-94	0.05	20	1.6	0.00003	0.007
AROCLOR-1016	1/7	1.3	1.3	1.3	X204-94	1		3.9	0.0029	0.007
AROCLOR-1254	2/7	3.2	3.2	3.2	X204-94 X205-94	1		0.22	0.0029	0.06
AROCLOR-1260	1/7	1.4	1.4	1.4	X204-94	1		0.22	0.0029	0.005
DELTA-BHC	2/7	0.12	0.13	0.13	X205-94	0.1	0.8	0.09	0.01	0.003
DIELDRIN	2/7	0.036	0.036	0.036	X205-94 X204-94	0.04	1	0.03	0.0005	0.052
ENDOSULFAN I	1/7	0.04	0.04	0.04	X205-94	470		370	0.00001	0.0029
ENDRIN	2/7	0.16	0.21	0.19	X204-94	23		18	0.00004	0.02
ENDRIN ALDEHYDE	2/7	0.085	0.096	0.091	X204-94	23		18		0.02
GAMMA-CHLORDANE	2/7	0.036	0.046	0.041	X205-94	0.05	20	1.6	0.00003	0.007
METHOXYCHLOR	1/7	0.11	0.11	0.11	X204-94	390		310		0.019

Note: Shaded values are screening values that are less than the maximum concentration.

IEPA = Illinois Environmental Protection Agency

TACO = Tiered Approach to Corrective Action Objectives

**TABLE A-10**  
**PETTIBONE CREEK BELOW CONFLUENCE SURFACE WATER**  
**FREQUENCY OF DETECTION**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
<b>INORGANICS</b>													
ALUMINUM	2/6	270	402	336	GL63-SW-PC-01		36000						87
IRON	3/6	496	720	596	GL63-SW-PC-01	5000	11000	300	300			300	1000
ARSENIC	6/6	1.1	3.1	1.6	GL63-SW-PC-01	50	0.045	0.018	0.018			50	148
BARIUM	6/6	37	55	42.8	GL63-SW-PC-02-F-D	2000	2600	1000	1000			1000	5000
CALCIUM	6/6	62500	68900	64767	GL63-SW-PC-01-F								
COPPER	6/6	6	40	19.8	GL63-SW-PC-02	650	1400	1000	1000				8.96
COPPER	6/6	6	40	19.8	GL63-SW-PC-02-D	650	1400	1000	1000				8.96
LEAD	1/6	1	1	0.75	GL63-SW-PC-02-F	7.5	15					50	5.08
MAGNESIUM	6/6	24200	27600	25133	GL63-SW-PC-01-F								
MANGANESE	6/6	22	43	30.2	GL63-SW-PC-01	150	880	50	50				1000
POTASSIUM	6/6	3400	3770	3550	GL63-SW-PC-01-F								
SODIUM	6/6	51100	64600	55333	GL63-SW-PC-01-F								
ZINC	3/6	9	15	11.3	GL63-SW-PC-02-F-D	10000	1400		5000				118
<b>VOLATILE ORGANIC COMPOUNDS</b>													
CARBON DISULFIDE	1/3	34	34	34	GL63-SW-PC-01	700	1000						0.92

Note: Shaded values are screening values that are less than the maximum concentration.

MCL = Maximum Concentration Limit

AWQC = Ambient Water Quality Criteria



TABLE A-11

**BOAT BASIN SEDIMENT  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2**

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
<b>INORGANICS</b>										
ALUMINUM	10/10	3130	9110	6100	GL63-SD-BB-04A			76000	50	
ARSENIC	14/15	1	24.4	9.7	GL63-SD-BB-04A	0.4	750	0.39	10	8
BARIUM	10/10	20.8	150	69.3	GL63-SD-BB-04A	5500	690000	5400	160	145
BERYLLIUM	13/13	0.39	9.3	1.4	GL63-SD-BB-01A	0.1	1300	150	1.1	
CADMIUM	14/15	0.8	11.9	3.5	GL63-SD-BB-04A	78	1800	37	0.8	0.5
CALCIUM	10/10	39300	71400	57210	GL63-SD-BB-02A					
CHROMIUM	15/15	0.013	86.3	27.2	GL63-SD-BB-03B	390	270	30	0.4	16
COBALT	10/10	6	12.5	8.03	GL63-SD-BB-04A	4700		4700	9	
COPPER	14/15	49	1560	358	GL63-SD-BB-04A	2900		2900	36	38
CYANIDE	7/15	0.21	14.5	6.6	GL63-SD-BB-04A	1600		11	0.9	
IRON	10/10	12000	24000	16400	GL63-SD-BB-04A			23000	200	18000
LEAD	15/15	0.09	848	272	X116-91	400		400	50	28
MAGNESIUM	10/10	19400	38800	29270	X116-91					
MANGANESE	10/10	342	755	565.5	GL63-SD-BB-04A	3700	69000	1800	100	1300
MERCURY	14/15	0.024	2.5	0.92	GL63-SD-BB-03B	23	10		0.3	0.07
NICKEL	14/15	8.5	217	69.9	GL63-SD-BB-02B	1600	13000	1600	30	26
POTASSIUM	10/10	570	2030	1271	GL63-SD-BB-02B					1500
SELENIUM	7/13	0.81	2.4	1.3	GL63-SD-BB-03B	390		390	0.7	
SILVER	10/13	1.5	85.9	24.5	GL63-SD-BB-02B	390		390	2	5
SODIUM	9/10	170	463	273	X203-94					
VANADIUM	10/10	10.8	23.2	17.1	GL63-SD-BB-04A GL63-SD-BB-02B	550		550	2	
ZINC	14/15	280	2200	901	GL63-SD-BB-04A	23000		23000	50	80
<b>MISCELLANEOUS</b>										
TOTAL ORGANIC CARBON	6/6	1190	15000	6470	B-104	16000	650	520	0.01	0.11
TOTAL SOLIDS	3/3	63	80.9	74.5	B-202	16000	650	520	0.01	0.11
<b>SEMIVOLATILE ORGANIC COMPOUNDS</b>										
2-METHYLNAPHTHALENE	7/11	0.08	0.31	0.17	X203-94	3100				0.368
ACENAPHTHENE	8/17	0.098	0.85	0.24	X203-94	4700		3700	20	0.585
ACENAPHTHYLENE	2/17	0.00016	0.00028	0.070	B-103	4700		3700		0.186
ANTHRACENE	10/17	0.0026	1.2	0.33	X203-94	23000		22000	0.1	0.085
BENZO(A)ANTHRACENE	12/17	0.0021	1.2	0.67	GL63-SD-BB-04A GL63-SD-BB-01B	0.9		0.62	0.1	0.287
BENZO(A)PYRENE	13/17	0.092	2.5	0.75	X203-94	0.09		0.062	0.1	0.073
BENZO(B)FLUORANTHENE	12/17	0.26	1.4	0.80	X116-91	0.9		0.62		0.886
BENZO(G,H,I)PERYLENE	4/17	0.16	1.3	0.53	X116-91	3100		56	0.1	0.17

TABLE A-11  
BOAT BASIN SEDIMENT  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 2

Parameter	Frequency of Detection	Minimum Detection (mg/kg)	Maximum Detection (mg/kg)	Average of Detections (mg/kg)	Location of Maximum Detection	IEPA Taco Exposure Route-Specific Values for Soils Ingestion (mg/kg)	IEPA Taco Exposure Route-Specific Values for Soils Inhalation (mg/kg)	EPA Region IX Soil Residential (mg/kg)	Ecological Soil Screening Values (mg/kg)	Ecological Sediment Screening Values (mg/kg)
BENZO(K)FLUORANTHENE	10/14	0.2	3.5	1.02	X203-94	9		6.2	0.1	8.86
BIS(2-ETHYLHEXYL)PHTHALATE	7/15	0.00097	3	1.1	GL63-SD-BB-03A	46	31000	35	0.017	
BUTYL BENZYL PHTHALATE	2/14	0.00056	0.0014	0.071	B-103	16000	930	12000	0.017	11
CARBAZOLE	6/10	0.11	1.5	0.38	X203-94	32		24		
CHRYSENE	13/14	0.35	3.8	1.1	X203-94	88		62	0.1	0.4
DI-N-BUTYL PHTHALATE	1/11	0.98	0.98	0.53	X203-94	7800	2300	6100	200	11
DI-N-OCTYL PHTHALATE	3/11	0.91	2.1	0.93	GL63-SD-BB-02A	1600	10000	1200	0.017	
DIBENZO(A,H)ANTHRACENE	3/14	0.055	0.26	0.17	B-204	0.09		0.062		0.06
DIBENZOFURAN	4/11	0.074	0.6	0.26	X203-94			290		2
FLUORANTHENE	12/14	0.17	4.3	1.9	X116-91	3100		2300	0.1	2.79
FLUORENE	11/14	0.078	0.98	0.27	X203-94	3100		2600	30	0.035
INDENO(1,2,3-CD)PYRENE	6/14	0.19	1.2	0.54	X116-91	0.9		0.62	0.1	2.5
NAPHTHALENE	2/11	0.29	0.6	0.37	X203-94	3100		56	0.1	0.34
PHENANTHRENE	13/14	0.41	5.7	1.8	X203-94	3100		56	0.1	0.81
PYRENE	13/14	0.45	4	1.4	X116-91			2300		0.35
<b>VOLATILE ORGANIC COMPOUNDS</b>										
1,1,1-TRICHLOROETHANE	1/10	0.013	0.013	0.013	X203-94		1200	630	0.07	0.17
2-BUTANONE	5/10	0.009	0.02	0.012	X203-94			7300		
ACETONE	1/10	0.026	0.026	0.018	X203-94	7800	100000	1600		
METHYLENE CHLORIDE	3/10	0.008	0.055	0.033	GL63-SD-BB-01A	85	13	8.9		
TOLUENE	1/10	0.004	0.004	0.0040	X203-94	16000	650	520	0.01	0.11
XYLENES, total	2/10	0.004	0.006	0.0050	X203-94	160000	410	210	0.1	0.14
<b>PESTICIDES / PCBS</b>										
4,4'-DDD	9/12	0.21	0.72	0.38	GL63-SD-BB-03B	3		2.4	0.0033	0.008
4,4'-DDE	9/12	0.074	0.35	0.16	X203-94	2		1.7	0.0033	0.005
4,4'-DDT	9/12	0.051	0.19	0.093	X203-94	2		1.7	0.0033	0.007
ALPHA-BHC	1/11	0.0055	0.0055	0.0055	X203-94	0.1	0.8	0.09	0.003	0.006
ALPHA-CHLORDANE	5/11	0.013	0.021	0.018	GL63-SD-BB-03B	0.05	20	1.6	0.00003	0.007
AROCLOR-1254	7/15	0.82	2.4	1.3	B-204	1		0.22	0.0029	0.06
DIELDRIN	1/11	0.012	0.012	0.012	X203-94	0.04	1	0.03	0.0005	0.052
ENDRIN	1/11	0.062	0.062	0.062	X203-94	23		18	0.00004	0.02
GAMMA-CHLORDANE	1/11	0.021	0.021	0.021	X203-94	0.05	20	1.6	0.00003	0.007
TOTAL AROCLOR	1/2	0.0121	0.0121	0.012	B-2	1		0.22	0.0029	0.06

Notes: Shaded values are screening values that are less than the maximum concentration.

IEPA = Illinois Environmental Protection Agency

TACO = Tiered Approach to Corrective Action Objectives

TABLE A-12

**BOAT BASIN SURFACE WATER  
FREQUENCY OF DETECTION  
SITE 17  
NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Minimum Detection (ug/L)	Maximum Detection (ug/L)	Average of Detections (ug/L)	Location of Maximum Detection	Groundwater Remediation Objective Class I (ug/L)	Region IX Tapwater (ug/L)	FED MCL (ug/L)	FED AWQC (ug/L)	Illinois Human Health Water Quality Standards (ug/L)	Subtitle D (ug/L)	Illinois Human Health Water Quality Criteria (ug/L)	Ecological Surface Water Screening Values (ug/L)
<b>INORGANICS</b>													
ALUMINUM	2/6	87	350	218.5	GL63-SW-BB-03		36000						87
COPPER	1/6	8	8	8	C-5	650	1400	1000	1000				8.96
IRON	3/6	162	554	388.3	GL63-SW-BB-03	5000	11000	300	300			300	1000
NICKEL	1/6	8	8	8	C-5	100	730	610	610				52.01
ZINC	2/6	41	44	42.5	GL63-SW-BB-01	10000	1400		5000				118
ARSENIC	1/4	1.4	1.4	1.4	GL63-SW-BB-03-F	50	0.045	0.018	0.018			50	148
BARIUM	6/6	31	52	38.8	C-5 C-5-F	2000	2600	1000	1000			1000	5000
BORON	2/2	560	573	567	C-5-F		3300						
CALCIUM	6/6	95	52500	32365	GL63-SW-BB-01								
CHROMIUM	3/5	9	11	10	C-5	100	110						11
MAGNESIUM	6/6	41	20800	12530	GL63-SW-BB-01								
MANGANESE	6/6	8	60	35.8	C-5	150	880	50	50				1000
POTASSIUM	6/6	4.1	2920	1640	GL63-SW-BB-01								
SODIUM	6/6	108	42100	22770	GL63-SW-BB-01								
STRONTIUM	2/2	370	373	372	C-5-F		22000						
<b>MISCELLANEOUS</b>													
AMMONIA	1/1	0.18	0.18	0.18	C-5		210						
CHEMICAL OXYGEN DEMAND	1/1	20	20	20	C-5								
HARDNESS	1/1	405	405	405	C-5								
NITRITE/NITRATE	1/1	1.1	1.1	1.1	C-5	10000	1000		10000				
PHOSPHORUS (ELEMENTAL)	2/2	0.08	0.12	0.1	C-5		0.73					7	
TOTAL SUSPENDED SOLIDS	1/1	6	6	6	C-5								
<b>VOLATILE ORGANIC COMPOUNDS</b>													
CIS-1,2-DICHLOROETHENE	1/1	2	2	2	C-5	70	61						590
TOLUENE	1/3	4	4	4	GL63-SW-BB-03	1000	720	6800	6800	51000	5600		110
XYLENES, TOTAL	1/3	4	4	4	GL63-SW-BB-03	10000	1400						120
TRICHLOROETHENE	1/3	1	1	1	C-5	5	1.6	2.7	2.7	370	29		940

Note: Shaded values are screening values that are less than the maximum concentration.

MCL = Maximum Concentration Limit

AWQC = Ambient Water Quality Criteria

**TABLE A-13**  
**PROJECT TARGET PARAMETERS, MATRICES, AND RATIONALES**  
**SITE 7**  
**NTC GREAT LAKES, ILLINIOS**

Parameter	Environmental Medium			Intended Data Use
	GW	SS	SB	
Target Compound List (TCL) Volatile Organics (to include ethyl alcohol and ethyl acetate)	X	X	X	Nature and extent
TCL Semivolatile Organics	X	X	X	Nature and extent
Target Analyte List (TAL) Metals	X	X	X	Nature and extent
Total Organic Carbon (TOC)	X	X	X	Organic chemical bioavailability
Toxicity Characteristic Leaching Procedure (TCL) organics and inorganics		X	X	Waste disposal characterization
Grain Size		X	X	Soil physical characterization
pH (f)	X			Aquifer stabilization
Turbidity (f)	X			Aquifer stabilization
Specific Conductance (f)	X			Aquifer stabilization
Dissolved Oxygen (f)	X			Aquifer stabilization
Hydraulic Conductivity (f)	X			Aquifer stabilization
Temperature (f)	X			Aquifer stabilization
Oxidation-Reduction Potential (ORP) (f)	X			Aquifer stabilization

(f) Field analysis  
GW – ground water  
SS – surface soil  
SB – subsurface soil

**TABLE A-14**  
**PROJECT TARGET PARAMETERS, MATRICES, AND RATIONALES**  
**SITE 17**  
**NTC GREAT LAKES, ILLINIOS**

Parameter	Environmental Medium		Intended Data Use
	SW	SD	
Target Compound List (TCL) Volatile Organics	X	X	10% of samples for verification
TCL Semivolatile Organics	X	X	10% of samples for verification
Target Analyte List (TAL) Metals	X	X	Nature and extent
TCL Pesticides	X	X	Nature and extent
TCL PCBs	X	X	Nature and extent
Polyaromatic Hydrocarbons (PAHs)	X	X	Nature and extent
Total Organic Carbon (TOC)		X	Organic chemical bioavailability
AVS / SEM		X	Metals bioavailability
Grain Size		X	Sediment physical characteristics
Toxicity Characteristic Leaching Procedure (TCL) organics and inorganics		X	Waste Disposal Characterization
Grain Size (f)		X	Sediment physical characteristics
pH (f)	X		

(f) Field analysis

SD – sediment

SW – surface water

AVS/SEM - Acid-volatile sulfide/simultaneously extracted metals

TABLE A-15

DETECTION LIMITS VERSUS RISK CRITERIA  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 1 OF 5

Analytes	CAS Number	Aqueous Matrix			Solid Matrix			
		Analytical Method MDL (µg/L)	Laboratory RL (µg/L)	Risk-Based Target Level <sup>(1)</sup> (µg/L)	Analytical Method MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Soil (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Sediment (mg/kg)
TCL VOLATILE ORGANIC COMPOUNDS								
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NA	10	59000	NA	0.01	120	5600
1,1,1-Trichloroethane	71-55-6	0.08	1	200	0.0017	0.01	0.07	0.17
1,1,2,2-Tetrachloroethane	79-34-5	0.04	1	0.055	0.0021	0.005	0.000034	0.38
1,1,2-Trichloroethane	79-00-5	0.1	1	0.2	0.0017	0.005	0.000039	0.84
1,1-Dichloroethane	75-34-3	0.04	1	47	0.002	0.005	0.02	590
1,1-Dichloroethene	75-35-4	0.12	1	0.046	0.0032	0.005	0.000018	0.054
1,2,4-Trichlorobenzene	120-82-1	0.04	1	69.2	NA	0.005	0.03	9.2
1,2-Dibromo-3-Chloropropane	96-12-8	0.26	1	0.048	NA	0.01	0.000044	0.45
1,2-Dibromoethane	106-93-4	0.06	1	0.00076	NA	0.005	0.00000043	0.0069
1,2-Dichlorobenzene	95-50-1	0.03	1	16.8	NA	0.005	0.03	0.34
1,2-Dichloroethane	107-06-2	0.06	1	0.12	0.0015	0.005	0.000052	0.35
1,2-Dichloropropane	78-87-5	0.04	1	0.16	0.0021	0.005	0.0001	0.35
1,3-Dichlorobenzene	541-73-1	0.12	1	5.5	NA	0.005	0.0044	1.7
1,4-Dichlorobenzene	106-46-7	0.03	1	0.5	NA	0.005	0.00036	0.35
2-Butanone (methyl ethyl ketone)	78-93-3	NA	5	1900	NA	0.02	0.4	7300
2-Hexanone	591-78-6	NA	5	99	0.0036	0.02	--	--
4-Methyl-2-pentanone	108-10-1	NA	5	160	0.0046	0.02	0.065	790
Acetone	67-64-1	NA	1	610	NA	0.02	0.12	1600
Benzene	74-43-2	0.04	1	0.35	0.0015	0.005	0.00009	0.006
Bromodichloromethane	75-27-4	0.08	1	0.02	0.0014	0.005	0.000054	1
Bromoform	75-25-2	0.12	1	0.2	0.0015	0.005	0.0033	62
Bromomethane	74-83-9	0.11	1	8.7	0.0049	0.01	0.0021	3.9
Carbon disulfide	75-15-0	NA	1	0.92	0.002	0.005	0.95	360
Carbon tetrachloride	56-23-5	0.21	1	0.17	0.0015	0.005	0.00011	0.24
Chlorobenzene	108-90-7	0.04	1	20	0.0014	0.005	0.03	0.82
Chloroethane	75-00-3	0.1	2	4.6	0.006	0.01	0.00096	3
Chloroform	67-66-3	0.03	1	0.02	0.0018	0.005	0.000045	0.24
Chloromethane	74-87-3	0.13	2	1.5	0.008	0.01	0.00052	1.2
cis-1,2-Dichloroethene	156-59-2	0.12	1	61	0.0023	0.005	0.017	43
cis-1,3-Dichloropropene	10061-01-5	NA	1	0.4	0.0017	0.005	0.00016	0.7
Cyclohexane	110-82-7	NA	10	35000		0.01	140	140
Dibromochloromethane	124-48-1	0.05	1	0.13	0.0015	0.005	0.000041	1.1
Dichlorodifluoromethane	75-71-8	0.1	2	390	NA	0.01	0.55	94
Ethylbenzene	100-41-4	0.06	1	17	0.0028	0.005	0.03	0.028
Isopropylbenzene	98-82-8	0.15	10	--(2)	NA	0.01	--	--
Methyl acetate	79-20-9	NA	10	6000	NA	0.01	1.2	22000
Methylcyclohexane	108-87-2	NA	10	5200	NA	0.01	2600	2600

TABLE A-15  
DETECTION LIMITS VERSUS RISK CRITERIA  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 2 OF 5

Analytes	CAS Number	Aqueous Matrix			Solid Matrix			
		Analytical Method MDL (µg/L)	Laboratory RL (µg/L)	Risk-Based Target Level <sup>(1)</sup> (µg/L)	Analytical Method MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Soil (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Sediment (mg/kg)
Methylene chloride	75-09-2	0.03	2	4.3	0.004	0.005	0.00095	8.9
Methyl tert-Butyl Ether	1634-04-4	NA	1	20	NA	0.005	--	--
Styrene	100-42-5	0.04	1	100	0.0014	0.005	0.2	1700
Tetrachloroethene	127-18-4	0.14	1	0.8	0.0016	0.005	0.002	0.53
Toluene	108-88-3	0.11	1	110	0.0033	0.005	0.01	0.11
trans-1,2-Dichloroethene	156-60-5	0.06	1	100	0.0014	0.005	0.03	63
trans-1,3-Dichloropropene	10061-02-6	NA	1	0.4	0.0017	0.005	0.00016	0.7
Trichloroethene	79-01-6	0.19	1	1.6	0.0017	0.005	0.00077	1.6
Trichlorofluoromethane	75-69-4	0.08	2	1300	NA	0.01	1.1	390
Vinyl chloride	75-01-4	0.17	2	0.041	0.006	0.01	0.000017	0.15
Xylenes, total	1330-20-7	0.29	3	120	0.0063	0.015	0.1	0.14
<b>TCL SEMIVOLATILE ORGANIC COMPOUNDS</b>								
1,1'-Biphenyl	92-52-4	NA	10	14	NA	0.33	4.8	350
2,4,5-Trichlorophenol	95-95-425	10	10	1	0.66	0.33	4	6100
2,4,6-Trichlorophenol	88-06-210	10	10	2	0.66	0.33	0.008	44
2,4-Dichlorophenol	120-83-210	10	10	0.3	0.66	0.33	0.01	180
2,4-Dimethylphenol	105-67-910	10	50	140	0.66	1.6	0.34	1200
2,4-Dinitrophenol	51-28-5	50	10	4.07	3.3	0.33	0.01	120
2,4-Dinitrotoluene	121-14-2	10	10	0.02	0.66	0.33	0.00004	0.9
2,6-Dinitrotoluene	606-20-2	10	10	0.1	0.66	0.33	0.00003	0.9
2-Chloronaphthalene	91-58-7	10	10	490	0.66	0.33	1.6	3900
2-Chlorophenol	95-57-810	10	10	0.1	0.66	0.33	0.01	63
2-Methylnaphthalene	91-57-610	10	10	25	0.66	0.33	84	0.368
2-Methylphenol (o-cresol)	95-48-710	10	10	350	0.66	0.33	0.05	3100
2,2'-Oxybis-1-Chloropropane	108-60-110	NA	10	0.27	NA	0.33	0.000084	2.9
2-Nitroaniline	88-74-4	50	50	2.1	3.3	1.6	3.5	3.5
2-Nitrophenol	88-75-510	10	10	290	0.66	0.33	0.087	490
3,3'-Dichlorobenzidine	91-94-1	20	50	0.04	1.3	1.6	0.00025	1
3-Nitroaniline	99-09-0	50	50	--	3.3	1.6	--	--
4-Bromophenyl phenyl ether	101-55-3	10	10	1.5	0.66	0.33	--	1.3
4-Chloro-3-methylphenol	59-50-710	20	10	3000	1.3	0.33	--	--
4-Chloroaniline	106-47-810	20	10	28	1.3	0.33	0.03	240
4-Chlorophenyl phenyl ether	7005-72-3	10	10	--	0.66	0.33	--	--
4-Methyl phenol	106-44-510	10	10	180	0.66	0.33	310	310
4-Nitroaniline	100-01-6	20	50	120	NA	1.6	--	--
4-Nitrophenol	100-02-7	50	50	290	3.3	1.6	0.087	490
4,6-Dinitro-2-methyl phenol	534-52-1	50	50	2.3	3.3	1.6	--	--
Acenaphthene	83-32-9	10	10	9.9	0.66	0.33	5.2	0.585

**TABLE A-15**  
**DETECTION LIMITS VERSUS RISK CRITERIA**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 3 OF 5**

Analytes	CAS Number	Aqueous Matrix			Solid Matrix			
		Analytical Method MDL (µg/L)	Laboratory RL (µg/L)	Risk-Based Target Level <sup>(1)</sup> (µg/L)	Analytical Method MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Soil (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Sediment (mg/kg)
Acenaphthylene	208-96-8	10	10	370	0.66	0.33	5.2	0.186
Acetophenone	98-86-210	10	10	0.042	NA	0.33	0.000011	0.49
Anthracene	120-12-7	10	10	0.73	0.66	0.33	0.1	0.085
Atrazine	1912-24-9	NA	10	0.3	NA	0.33	0.0002	2.2
Benzaldehyde	100-52-710	NA	10	3600	NA	0.33	6100	6100
Benzo(a)anthracene	56-55-3	10	10	0.0044	0.66	0.33	0.073	0.287
Benzo(a)pyrene	50-32-810	10	10	0.0044	0.66	0.33	0.019	0.062
Benzo(b)fluoranthene	205-99-210	10	10	0.0044	0.66	0.33	0.2	0.62
Benzo(g,h,i)perylene	191-24-210	10	10	6.2	0.66	0.33	0.0077	0.17
Benzo(k)fluoranthene	207-08-910	10	10	0.0044	0.66	0.33	0.1	6.2
Bis(2-chloroethoxy)methane	111-90-110	10	10	--	0.66	0.33	--	--
Bis(2-chloroethyl)ether	111-44-410	10	10	0.0098	0.66	0.33	0.0000022	0.21
Bis(2-ethylhexyl)phthalate	117-81-7	10	10	1.8	0.66	0.33	0.017	35
Butyl benzyl phthalate	85-68-7	10	10	19	0.66	0.33	0.017	11
Caprolactam	105-60-210	NA	10	18000	NA	0.33	31000	31000
Carbazole	86-74-8	NA	10	3.4		0.33	0.023	24
Chrysene	218-01-9	10	10	0.0044	0.66	0.33	0.1	0.4
Dibenzo(a,h)anthracene	53-70-310	10	10	0.0044	0.66	0.33	0.062	0.06
Dibenzofuran	132-64-9	10	10	3.7	0.66	0.33	0.38	2
Diethyl phthalate	84-66-2	10	10	210	0.66	0.33	23	0.63
Dimethyl phthalate	131-11-3	10	10	313000	0.66	0.33	200	100000
Di-n-butyl phthalate	84-74-2	10	10	35	0.66	0.33	200	11
Di-n-octyl phthalate	117-84-0	10	10	140	0.66	0.33	0.017	1200
Fluoranthene	206-44-0	10	10	6.16	0.66	0.33	0.1	2.79
Fluorene	86-73-7	10	10	3.9	0.66	0.33	6.8	0.035
Hexachlorobenzene	118-74-1	10	10	0.00025	0.66	0.33	0.0026	0.3
Hexachlorobutadiene	87-68-310	10	10	0.44	0.66	0.33	0.092	6.2
Hexachlorocyclopentadiene	77-47-410	10	50	50	0.66	1.6	10	420
Hexachloroethane	67-72-110	10	10	1.9	0.66	0.33	0.018	1
Indeno(1,2,3-cd)pyrene	193-39-510	10	10	0.0044	0.66	0.33	0.1	0.62
Isophorone	78-59-110	10	10	36	0.66	0.33	0.021	510
Naphthalene	91-20-310	10	10	6.2	0.66	0.33	0.0077	0.34
Nitrobenzene	98-95-310	10	10	3.4	0.66	0.33	0.0012	20
N-Nitroso-Di-n-Propylamine	621-64-710	10	10	0.005	0.66	0.33	0.000002	0.069
n-Nitrosodiphenylamine	86-30-6	10	10	5	0.66	0.33	0.038	99
Pentachlorophenol	87-86-5	50	50	0.28	3.3	1.6	0.001	3
Phenanthrene	85-01-8	10	10	3.7	0.66	0.33	0.0077	0.81
Phenol	108-95-210	10	10	0.1	0.66	0.33	0.05	37000



TABLE A-15

DETECTION LIMITS VERSUS RISK CRITERIA  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 4 OF 5

Analytes	CAS Number	Aqueous Matrix			Solid Matrix			
		Analytical Method MDL (µg/L)	Laboratory RL (µg/L)	Risk-Based Target Level <sup>(1)</sup> (µg/L)	Analytical Method MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Soil (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Sediment (mg/kg)
Pyrene	129-00-0	10	10	180	0.66	0.33	34	0.35
<b>TCL PESTICIDES AND PCBS</b>								
4,4'-DDD	72-54-8	1.4	0.05	0.000011	NA	0.0017	0.0033	0.008
4,4'-DDE	72-55-9	1	0.05	0.000011	NA	0.0017	0.0033	0.005
4,4'-DDT	50-29-3	0.6	0.05	0.000011	NA	0.0017	0.0033	0.007
Aldrin	309-00-2	1.4	0.05	0.00013	NA	0.0017	0.00006	0.002
alpha-BHC	319-84-6	NA	0.05	0.0039	NA	0.0017	0.00003	0.006
alpha-Chlordane	5103-71-9	1.5	0.05	0.00025	NA	0.0017	0.00003	0.007
beta-BHC	319-85-7	0.91	0.05	0.014	NA	0.0017	0.0001	0.005
delta-BHC	319-86-8	NA	0.05	0.0039	NA	0.0017	0.00003	0.003
Dieldrin	60-57-1	0.9	0.05	0.0000065	NA	0.0017	0.00011	0.03
Endosulfan I	959-98-8	1.3	0.05	0.056	NA	0.0017	0.00001	0.0029
Endosulfan II	33213-65-9	0.9	0.05	0.056	NA	0.0017	0.00001	0.014
Endosulfan sulfate	1031-07-8	NA	0.05	0.056	NA	0.0017	0.00001	0.0054
Endrin	72-20-8	1.7	0.05	0.036	NA	0.0017	0.00004	0.02
Endrin aldehyde	7421-93-4	0.8	0.05	0.036	NA	0.0017	0.05	0.02
Endrin ketone	53494-70-5	NA	0.05	0.036	NA	0.0017	0.05	0.02
gamma-BHC (Lindane)	58-89-9	1.4	0.05	0.019	NA	0.0017	0.00005	0.003
gamma-Chlordane	5103-74-2	1.8	0.05	0.00025	NA	0.0017	0.00003	0.007
Heptachlor	76-44-8	1.3	0.05	0.00021	NA	0.0017	0.0007	0.005
Heptachlor epoxide	1024-57-3	1.5	0.05	0.0001	NA	0.0017	0.0000002	0.005
Methoxychlor	72-43-5	NA	0.1	0.03	NA	0.0033	8	0.019
Toxaphene	8001-35-2	NA	2	0.000068	NA	0.067	0.031	0.028
Aroclor-1016	12674-11-2	NA	1	0.00012	NA	0.033	0.0029	0.007
Aroclor-1221	11104-28-2	NA	1	0.00012	NA	0.033	0.0029	0.07
Aroclor-1232	11141-16-5	NA	1	0.00012	NA	0.033	0.0029	0.07
Aroclor-1242	53469-21-9	NA	1	0.00012	NA	0.033	0.0029	0.07
Aroclor-1248	12672-29-6	NA	1	0.00012	NA	0.033	0.0029	0.03
Aroclor-1254	11097-69-1	NA	1	0.00012	NA	0.033	0.0029	0.06
Aroclor-1260	11096-82-5	NA	1	0.00012	NA	0.033	0.0029	0.005
<b>TAL METALS</b>								
Aluminum	7429-90-5	30	14.7	87	NA	0.0147	50	76000
Antimony	7440-36-0	21	2	6	NA	0.002	0.006	31
Arsenic	7440-38-2	35	2.1	0.018	NA	0.0021	0.0013	0.39
Barium	7440-39-3	0.87	0.4	1000	NA	0.0004	2	145
Beryllium	7440-41-7	0.18	0.13	0.66	NA	0.00013	0.004	0.1
Cadmium	7440-43-9	2.3	0.46	2.24	NA	0.00046	0.005	0.5
Calcium	7440-70-2	6.7	18.7	--	NA	0.0187	--	--

TABLE A-15

**DETECTION LIMITS VERSUS RISK CRITERIA  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 5 OF 5**

Analytes	CAS Number	Aqueous Matrix			Solid Matrix			
		Analytical Method MDL (µg/L)	Laboratory RL (µg/L)	Risk-Based Target Level <sup>(1)</sup> (µg/L)	Analytical Method MDL (mg/kg)	Laboratory RL (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Soil (mg/kg)	Risk-Based Target Level <sup>(1)</sup> Sediment (mg/kg)
Chromium	7440-47-3	4.7	1.2	11	NA	0.0012	0.1	16
Cobalt	7440-48-4	4.7	4.1	23	NA	0.0041	1	4700
Copper	7440-50-8	3.6	2	8.96	NA	0.002	0.65	38
Iron	7439-89-6	4.1	3.8	300	NA	0.0038	5	18000
Lead	7439-92-1	28	1.5	5.08	NA	0.0015	0.0075	28
Magnesium	7439-95-4	20	23.6	--	NA	0.0236	--	--
Manganese	7439-96-5	0.93	0.71	50	NA	0.00071	0.15	1300
Mercury	7439-97-6	17	0.079	0.0013	NA	0.000079	0.002	0.07
Nickel	7440-02-0	10	9.8	52.01	NA	0.0098	0.1	26
Potassium	7440-09-7		527	--	NA	0.527	--	1500
Selenium	7782-49-2	50	2.7	5	NA	0.0027	0.05	390
Silver	7440-22-4	4.7	1	0.36	NA	0.001	0.05	5
Sodium	7440-23-5	19	12.5	--	NA	0.0125	--	--
Thallium	7440-28-0	27	5.9	1.7	NA	0.0059	0.002	5.2
Vanadium	7440-62-2	5	2.6	20	NA	0.0026	0.049	550
Zinc	7440-66-6	1.2	2	118	NA	0.002	5	80
<b>MISCELLANEOUS PARAMETERS</b>								
Cyanide	57-12-5	NA	10	5.2	NA	0.5	0.9	11
DRO (SW-846 METHOD 8015B)		NA	100	--	NA	10	--	--
Ethyl Acetate (SW-846 METHOD 8015B)	141-78-6	8	1000	5500	0.18	1	1.7	19000
Ethyl Alcohol (SW-846 METHOD 8015B)	64-17-5	12	1000	--	0.47	1	--	--
Isopropyl Alcohol (SW-846 METHOD 8015B)	67-63-0	17	1000	7.5	0.47	1	--	--
Isopropyl Acetate (SW-846 METHOD 8015B)	108-21-4	NA	5000	--	NA	5	--	--
n-propyl Acetate (SW-846 METHOD 8015B)	109-60-4	NA	5000	--	NA	5	--	--

NA = Method detection limit not provided by specified SW-846 method.

RL = reporting limit

MDL = method detection limit

µg/L = micrograms per liter

mg/kg = milligrams per kilogram

Shaded cell indicate that MDLs exceed a risk-based target level for the project.

1. Value is the lowest of the human health or ecological risk-based criteria.

2. Risk-based target level is not provided because human and ecological risk-based criteria are not available for this parameter.

**TABLE A-16**  
**NON-CALIBRATION QC SAMPLE USAGE FREQUENCIES AND ACCEPTANCE LIMITS**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINIOS**  
**PAGE 1 OF 2**

QC Sample Type	Collection Frequency	Acceptance Limits	Corrective Action
Field Duplicate	1 per 10 investigative samples collected.	Aqueous = 30% RPD Soil/Sediment = 50% RPD	Qualify data according to data validation requirements.
Equipment Rinsate Blank	1 per 10 investigative samples collected, with a minimum of 1 per day of sampling, per non-disposable sampling device/instrument.  For pre-cleaned, dedicated, and/or disposable equipment (i.e., disposable plastic trowels, etc.), one rinsate blank will be collected and analyzed at a frequency of one per lot or "batch blank" for a specific equipment type.	< MDL/IDL (soil and water)	Identify source of contamination, if possible. Qualify data according to validation criteria. Qualify use of data if contamination appears to have adversely affected its usability.
Source Water Blank	1 per each source of water used for sampling equipment decontamination.	< MDL/IDL (soil and water)	Identify source of contamination, if possible. Qualify data according to validation criteria. Qualify use of data if contamination appears to have adversely affected its usability.
Trip Blanks	1 per cooler containing samples for volatile organics analysis	< MDL (soil and water)	Identify source of volatiles contamination, if possible. Qualify data according to validation criteria. Qualify use of data if contamination appears to have adversely affected its usability.
Internal Standard	At least 1 internal standard per sample for GC/MS analyses.	Retention times stable to $\pm 30$ seconds; area counts stable to within factor of 2.	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Laboratory Control Sample	1 per 20 environmental samples per matrix	See Tables B-17 through B-21 for quality control limits	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Laboratory Duplicate	1 per 20 environmental samples analyzed for inorganic target analytes	See Tables B-17 through B-21 for quality control limits	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.

**TABLE A-16**

**NON-CALIBRATION QC SAMPLE USAGE FREQUENCIES AND ACCEPTANCE LIMITS  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 2 OF 2**

QC Sample Type	Collection Frequency	Acceptance Limits	Corrective Action
Laboratory Method Blank	1 per 20 environmental samples or per preparation batch, whichever is more frequent	< RL (soil and water)	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Matrix Spike	1 per 20 environmental samples	See Tables B-12 through B-16 for quality control limits	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Matrix Spike Duplicate	1 per 20 environmental samples analyzed for organic target analytes	See Tables B-12 through B-16 for quality control limits	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Post-digestion Spike	Only if matrix spike is out-of-control matrix spike (metals only)	100 ± 20%	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Surrogate	At least 1 per sample for organic chromatographic analyses (GC, GC/MS, and HPLC)	See Tables B51 through B5.7 for quality control limits	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.
Temperature Blank	One blank per sample cooler.	4 ± 2 °C	Laboratory action taken per STL-QC-003. TtNUS action taken per validation protocols.

RPD Relative percent differences  
MDL Method detection limit  
IDL Instrument detection limit  
GC Gas Chromatograph  
MS Mass Spectrometer  
HPLC High Performance Liquid Chromatography  
RL Reporting Limit

**TABLE A-17**  
**LABORATORY DATA PACKAGE ELEMENTS**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINIOS**  
**PAGE 1 OF 3**

DATA PACKAGE ELEMENTS	Volatiles	Semi-volatiles	Pesticides / PCBs	Metals	Miscellaneous <sup>(1)</sup>
♦ INVENTORY SHEET (Org. and Inorg. DC-2 Form)	X	X	X	X	X
♦ NARRATIVE (Org. Narrative, Inorg. Cover Page)	X	X	X	X	X
♦ EPA SHIPPING/RECEIVING DOCUMENTS AND INTERNAL LABORATORY COC RECORDS:					
- Airbills	X	X	X	X	X
- Chain-of-Custody Records/Forms (Traffic Report)	X	X	X	X	X
- Sample Log-In Sheet (Org. and Inorg. DC-1 Form)	X	X	X	X	X
- Miscellaneous Shipping/Receiving Records	X	X	X	X	X
- Internal Lab. Sample Transfer Records and Tracking Sheets	X	X	X	X	X
♦ SAMPLE DATA:					
- Tabulated Summary Form for Field Sample and PE Sample Results (Org. and Inorg. Form I)	X	X	X	X	X
- Tentatively Identified Compounds Tabulate Summary Form (Org. Form I TIC)					
- Reconstructed Total Ion Chromatogram (RIC) for each sample	X	X			
- Raw spectra of target compound and background subtracted spectrum of target compound for each sample	X	X			
- Mass spectra of all reported TICs/three best library matches for each sample					
- Chromatograms from both columns for each sample			X		
- GC Integration report or data system printouts and calibration plots for each sample	X	X	X	X	X
- Pesticide/PCB Identification Tabulated Summary Form (Org. Form X)			X		
- For Pest/PCB confirmed by GC/MS, copies of raw spectra and background subtracted spectrum of target compounds			X		
- GPC sample chromatograms			X		
- Manual worksheets	X	X	X	X	X
- Sample preparation/extraction/digestion log (Inorg. Form XIII) and logbook pages	X	X		X	X
- Sample analysis run log (Inorg. Form XIV) and logbook pages	X	X		X	X
- ICP Raw Data				X	
- Furnace AA Raw Data					
- Mercury Raw Data				X	

TABLE A-17

**LABORATORY DATA PACKAGE ELEMENTS  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 2 OF 3**

DATA PACKAGE ELEMENTS	Volatiles	Semi-volatiles	Pesticides / PCBs	Metals	Miscellaneous <sup>(1)</sup>
- Cyanide Raw Data				X	
- Other Analytical Raw Data	X	X	X	X	X
♦ <b>STANDARDS DATA:</b>					
- Method Detection Limit Study Tabulated Summary Form	X	X	X	X	X
- Initial Calibration Tabulated Summary Form (Org. Form VI, Inorg. Form IIA)	X	X	X	X	X
- Continuing Calibration Tabulated Summary Form (Org. Form VII, Inorg. Form IIA)	X	X			
- RICs and Quan Reports for all GC/MS standards			X		
- Pesticides Analyte Resolution tabulated Summary Form (Org. Form VI, Pest-4)			X		
- Pesticides Calibration Verification Tabulated Summary Form (Org. Form VII, Pest-1 and Pest-2)			X		
- Pesticide Analytical Sequence Tabulated Summary Form (Org. Form VIII-Pest)			X		
- GC Chromatograms and data system printouts for all GC standards			X		
- For Pesticides/Aroclors confirmed by GC/MS, copies of spectra for standards data			X		
- GPC Calibration Tabulated Summary Form (Org. Form IX, Pest-2)			X		
- Florisil Cartridge Check Tabulated Summary Form (Org. Form IX, Pest-1)			X		
- Instrument Detection Limits Tabulated Summary Form (Inorg. Form X)				X	
- ICP Interement Correction Factors Tabulated Summary Form (Inorg. Form XIA and XIB)				X	
- ICP Linear Ranges Tabulated Summary Form (Inorg. Form XII)				X	
- CRDL Standards for AA and ICP Tabulated Summary Form (Inorg. Form IIB)				X	
- Standards preparation logbook pages	X	X	X	X	X
♦ <b>QC DATA:</b>					
- Tuning and Mass Calibration Tabulated Summary Form (Org. Form V)	X	X			
- Surrogate Percent Recovery Tabulated Summary Form (Org. Form II)	X	X	X		
- MS/MSD Recovery Tabulated Summary Form (Org. Form III)	X	X	X		
- Method Blank Tabulated Summary Form (Org. Form IV and Inorg. Form III)	X	X	X	X	X
- Internal Standard Area and RT Tabulated Summary Form (Org. Form VIII)	X	X			

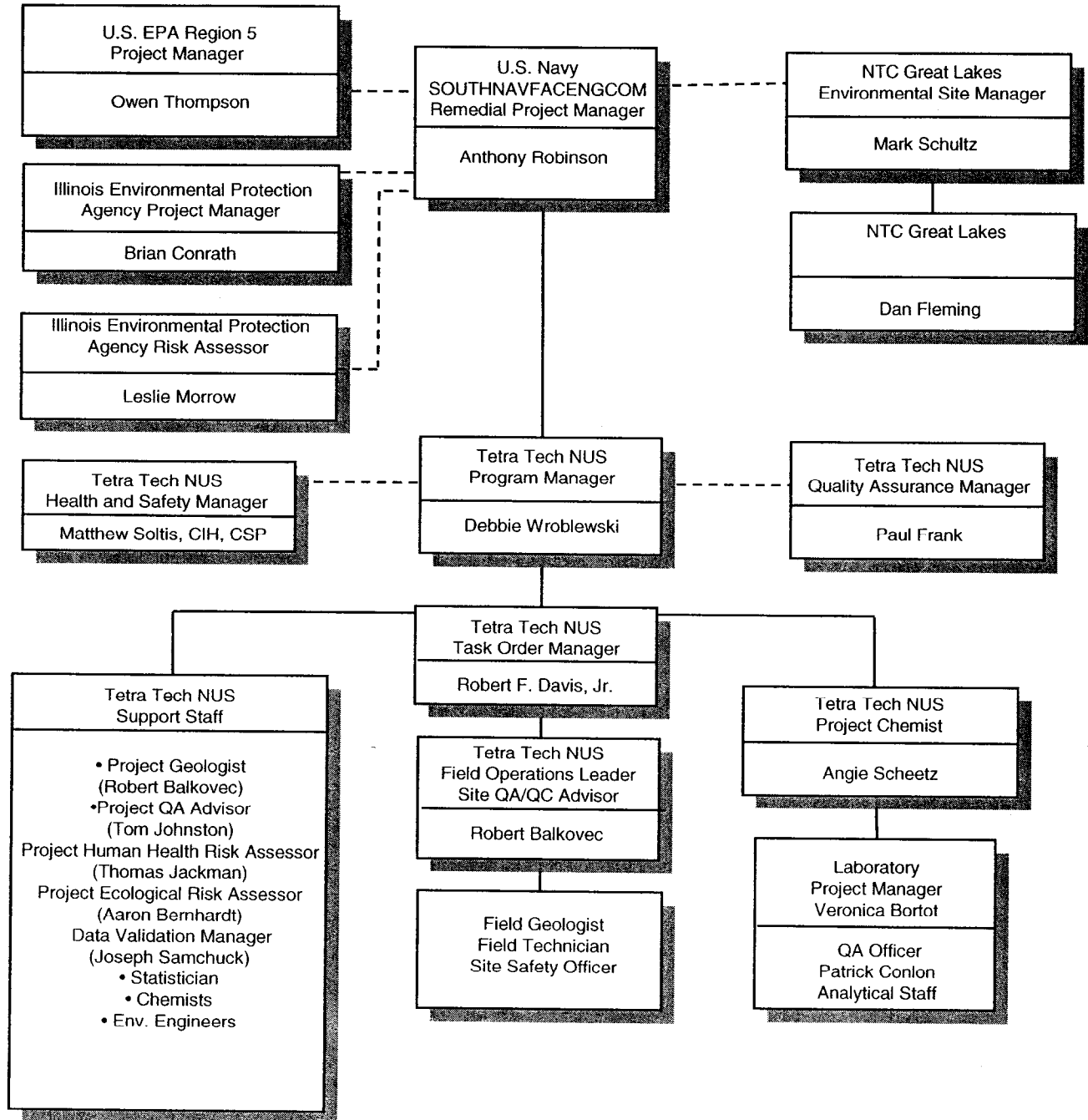
**TABLE A-17**  
**LABORATORY DATA PACKAGE ELEMENTS**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINIOS**  
**PAGE 3 OF 3**

DATA PACKAGE ELEMENTS	Volatiles	Semi-volatiles	Pesticides / PCBs	Metals	Miscellaneous <sup>(1)</sup>
- QC Raw Data – RICs, Chromatograms, Quan Reports, Integration Reports, Mass Spectra, etc.	X	X	X	X	X
- Spike Sample Recovery Tabulated Summary Form (Inorg. Form IV)				X	X
- Duplicates Tabulated Summary Form (Inorg. Form VI)				X	X
- Internal Laboratory Control Sample Tabulated Summary Form (Inorg. Form VII)				X	X
- Continuing Calibration Tabulated Summary Form (Org. Form VII, Inorg. Form IIA)	X	X	X	X	X
- Standard Addition Results Tabulated Summary Form (Inorg. Form VIII)					
- ICP Serial Dilutions Tabulated Summary Form (Inorg. Form IV)				X	
- QC Raw Data – ICP, Furnace, Mercury computer printouts, etc.				X	
- QC sample preparation logbook pages	X	X	X	X	X
♦ <b>MISCELLANEOUS DATA:</b>					
- Original preparation and analysis forms or copies of preparation and analysis logbook pages	X	X	X	X	X
- Screening records	X	X	X	X	X
- All instrument output, including strip charts from screening activities	X	X	X	X	X
- Preparation Logs Raw Data	X	X	X	X	X
- Percent Solids Determination Log	X	X	X	X	X
- Other Records (ex. Telephone Communication Log)	X	X	X	X	X

<sup>(1)</sup> Miscellaneous data package will include information as applicable to the method.

FIGURE A-1

**PROJECT ORGANIZATION CHART  
SITE 7 RTC SILK SCREENING SHOP AND  
SITE 17 PETTIBONE CREEK/BOAT BASIN  
NTC GREAT LAKES, GREAT LAKES, ILLINOIS**



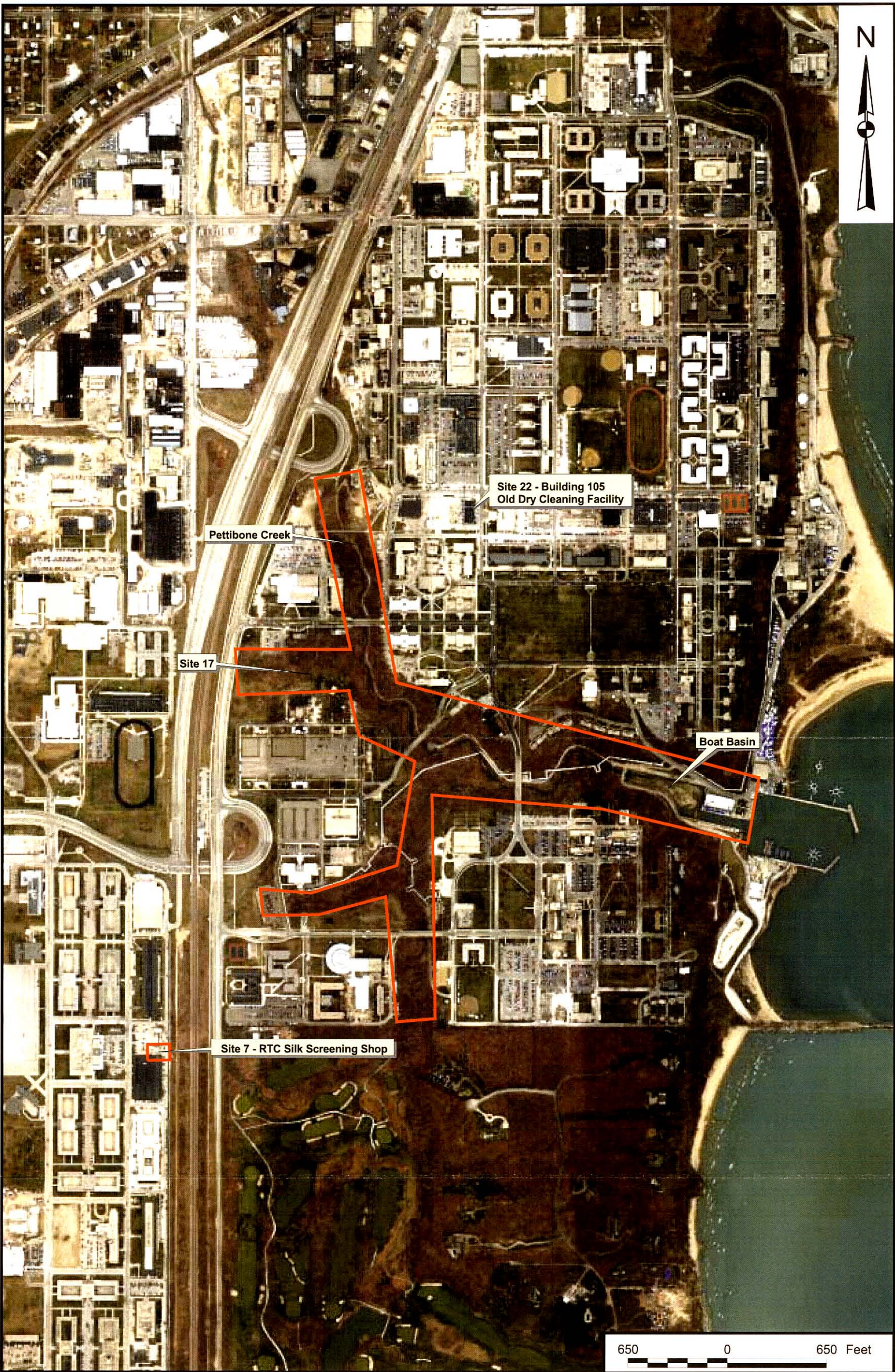




DRAWN BY J. BELLONE		DATE 4/5/01			SITE LOCATION MAP SITE 17 NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS		CONTRACT NUMBER N1474	
CHECKED BY R. DAVIS		DATE 4/22/03					APPROVED BY RFD	DATE 4/20/03
COST/SCHEDULE AREA		SCALE AS NOTED					APPROVED BY	DATE
DRAWING NO. FIGURE A - 2				REV 0				

00014908018





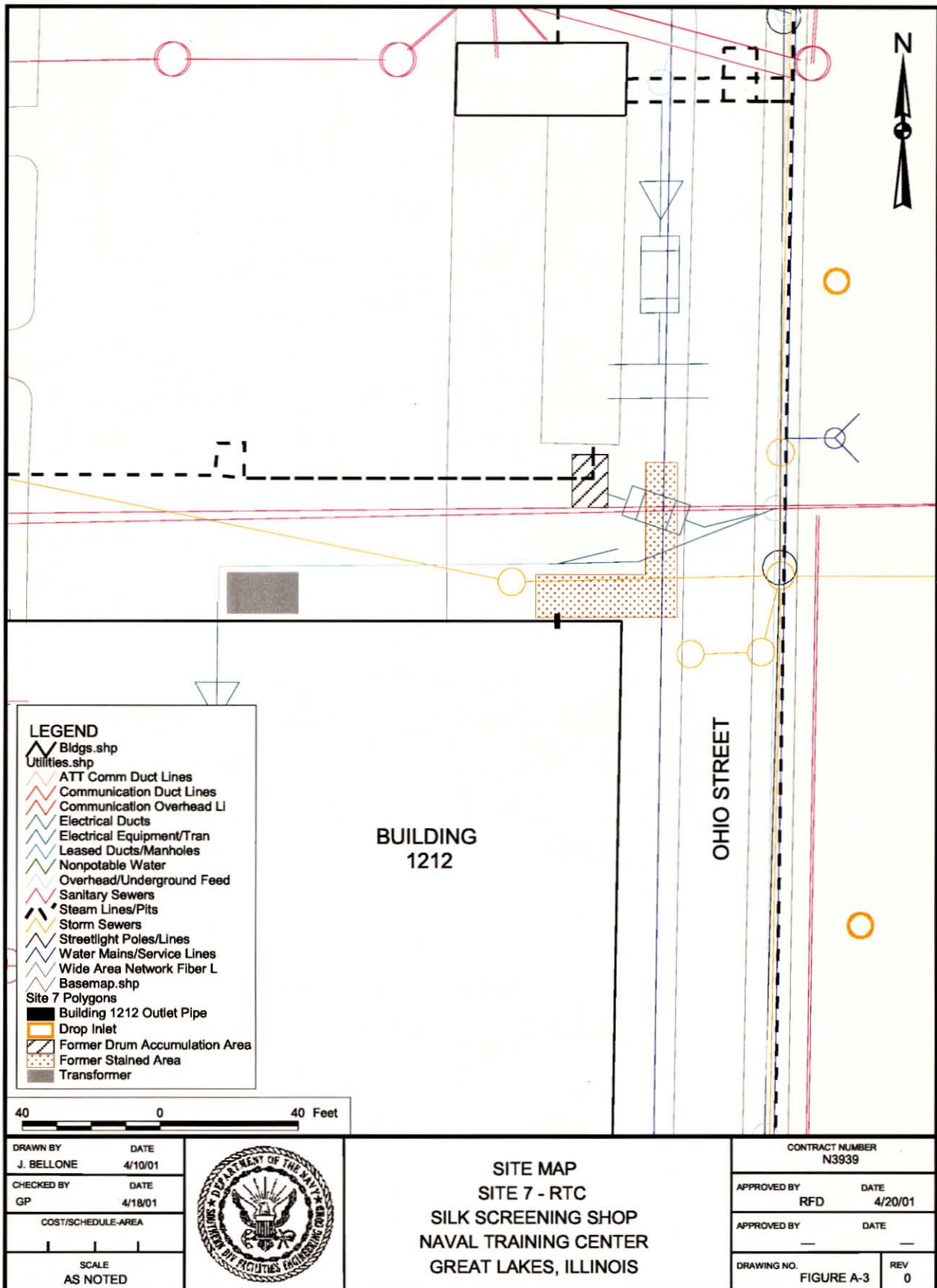
DRAWN BY	DATE
J. BELLONE	4/5/01
CHECKED BY	DATE
R. DAVIS	6/25/03
COST/SCHEDULE-AREA	
SCALE AS NOTED	



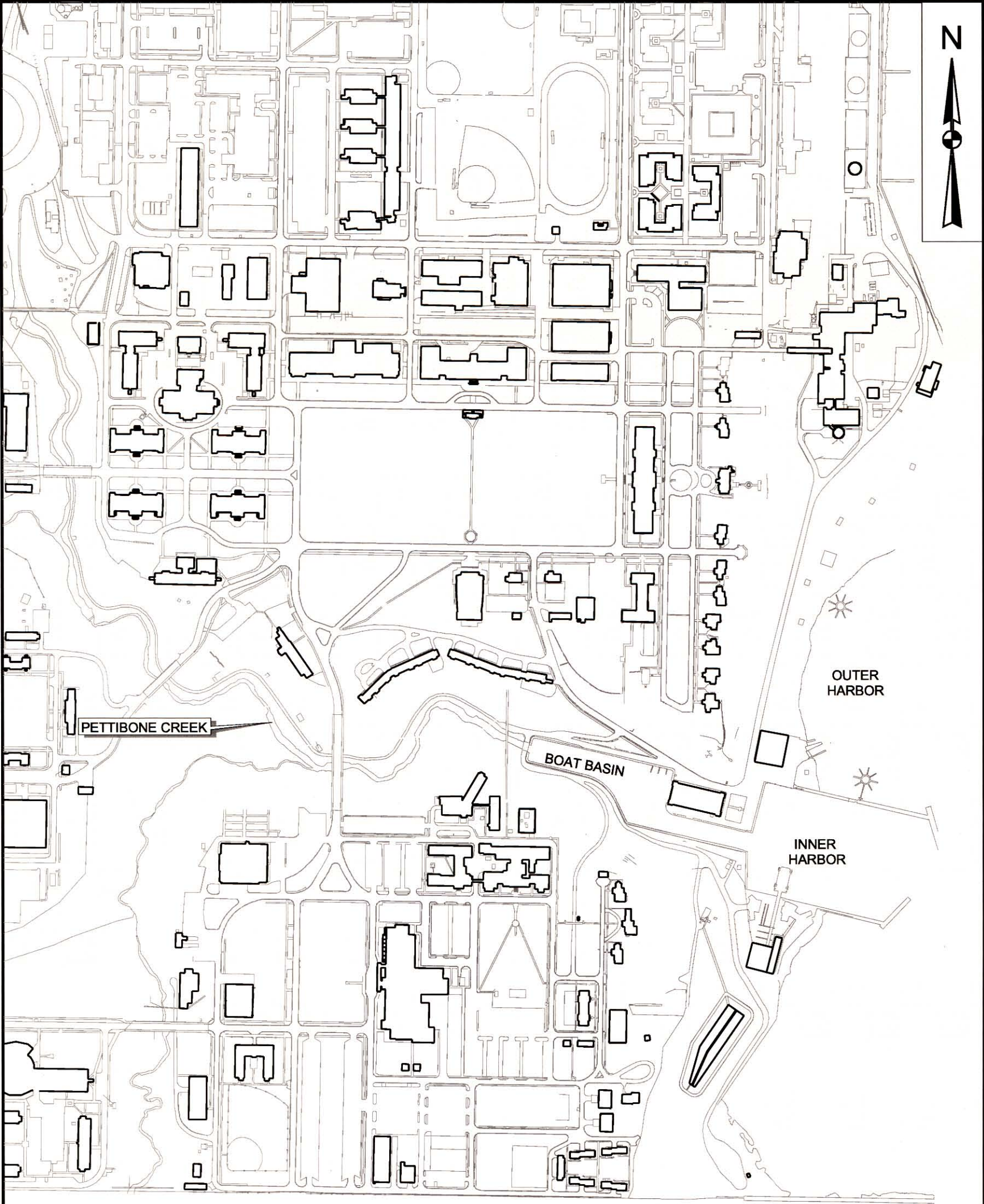
SITE LOCATION MAP  
SITES 7, 17, AND 22  
NAVAL TRAINING CENTER  
GREAT LAKES, ILLINOIS

CONTRACT NUMBER N1474	
APPROVED BY	DATE
RFD	4/20/03
APPROVED BY	DATE
DRAWING NO. FIGURE A - 2	REV 0









LEGEND

Building Outline

Basemap



DRAWN BY	DATE
J. BELLONE	4/5/01
CHECKED BY	DATE
GP	4/18/01
COST/SCHEDULE-AREA	
SCALE	
AS NOTED	



SITE MAP

SITE 17 - PETTIBONE CREEK AND BOAT BASIN

NAVAL TRAINING CENTER

GREAT LAKES, ILLINOIS

CONTRACT NUMBER	
N3939	
APPROVED BY	DATE
RFD	4/20/01
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE A-4	0

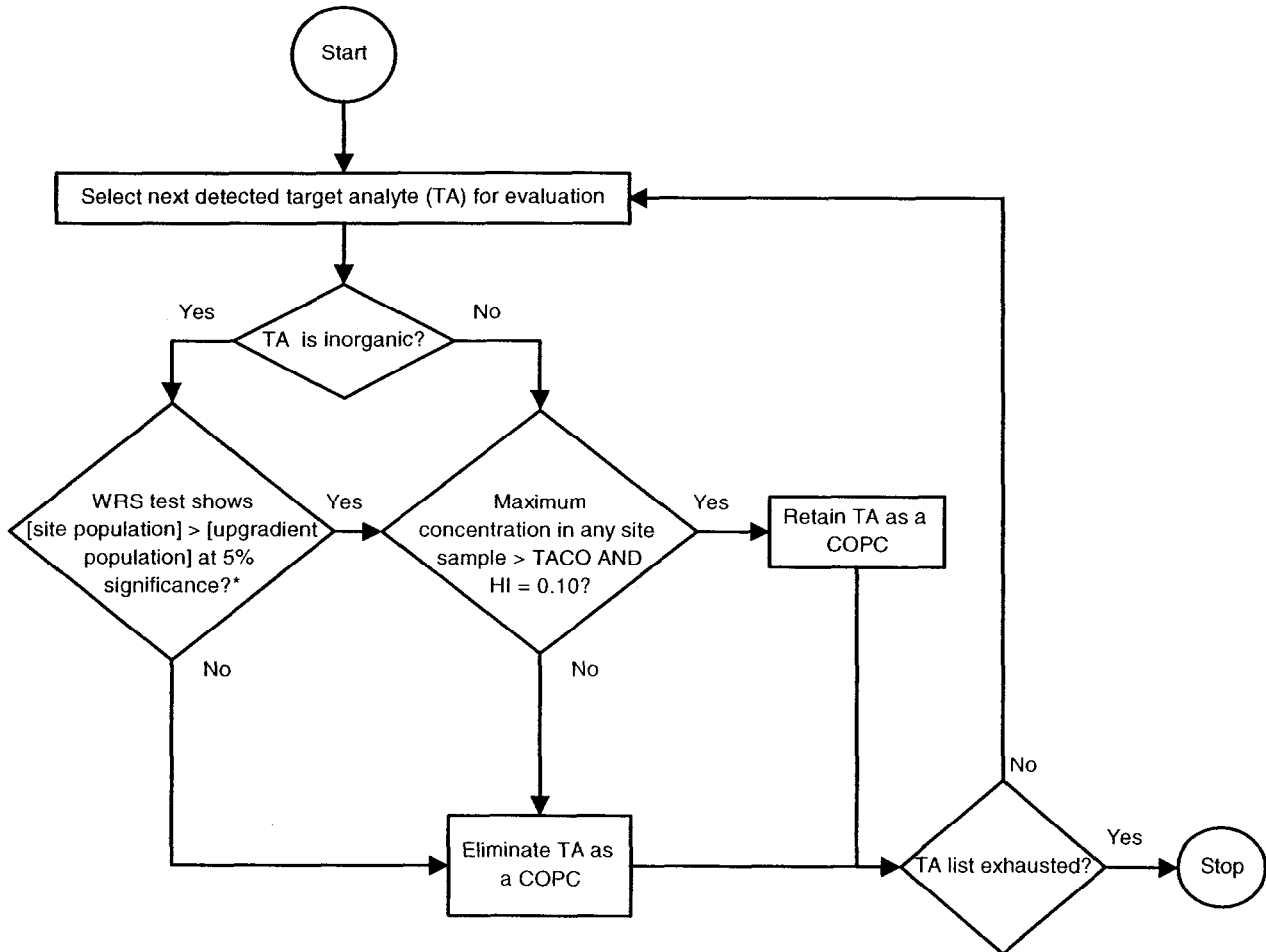






FIGURE A-6

**SITE 7 AND 22 HUMAN HEALTH RISK ASSESSMENT COPC SELECTION  
IN GROUND WATER  
NTC GREAT LAKES**



COPC = Chemical of potential concern

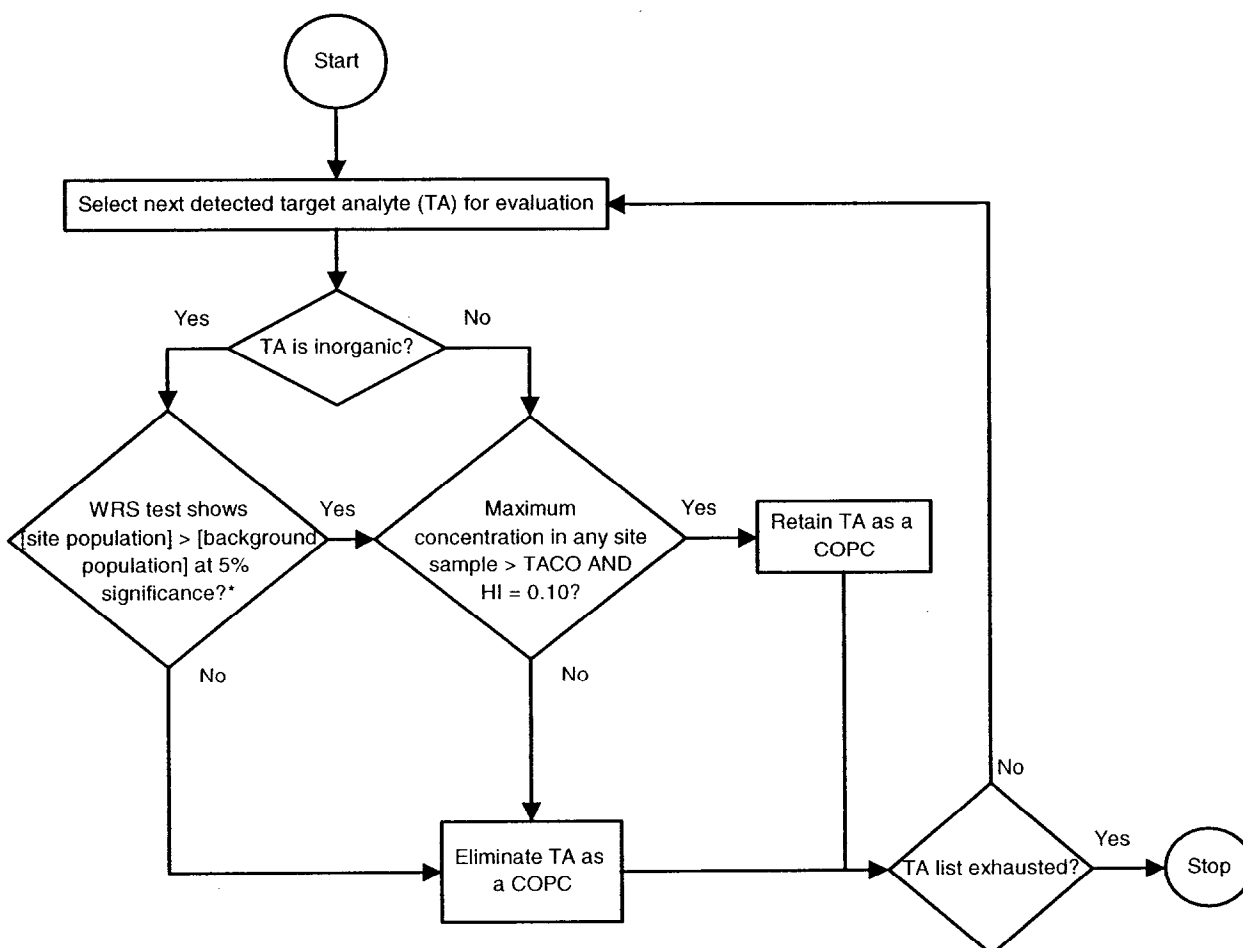
TACO = Tiered Assessment Criteria Objective

WRS = Wilcoxon Rank Sum

\* The upgradient population will be represented by samples from upgradient monitoring wells. Sample depths for site and upgradient wells will be matched as closely as practicable to represent corresponding aquifers/depths. If the WRS test proves to be inappropriate (for example, because of a limited number of detectable results), an appropriate statistical test suited to this type of evaluation will be selected.

FIGURE A-7

**SITE 7 AND 22 HUMAN HEALTH RISK ASSESSMENT COPC SELECTION  
IN SURFACE AND SUBSURFACE SOIL  
NTC GREAT LAKES**



COPC = Chemical of potential concern

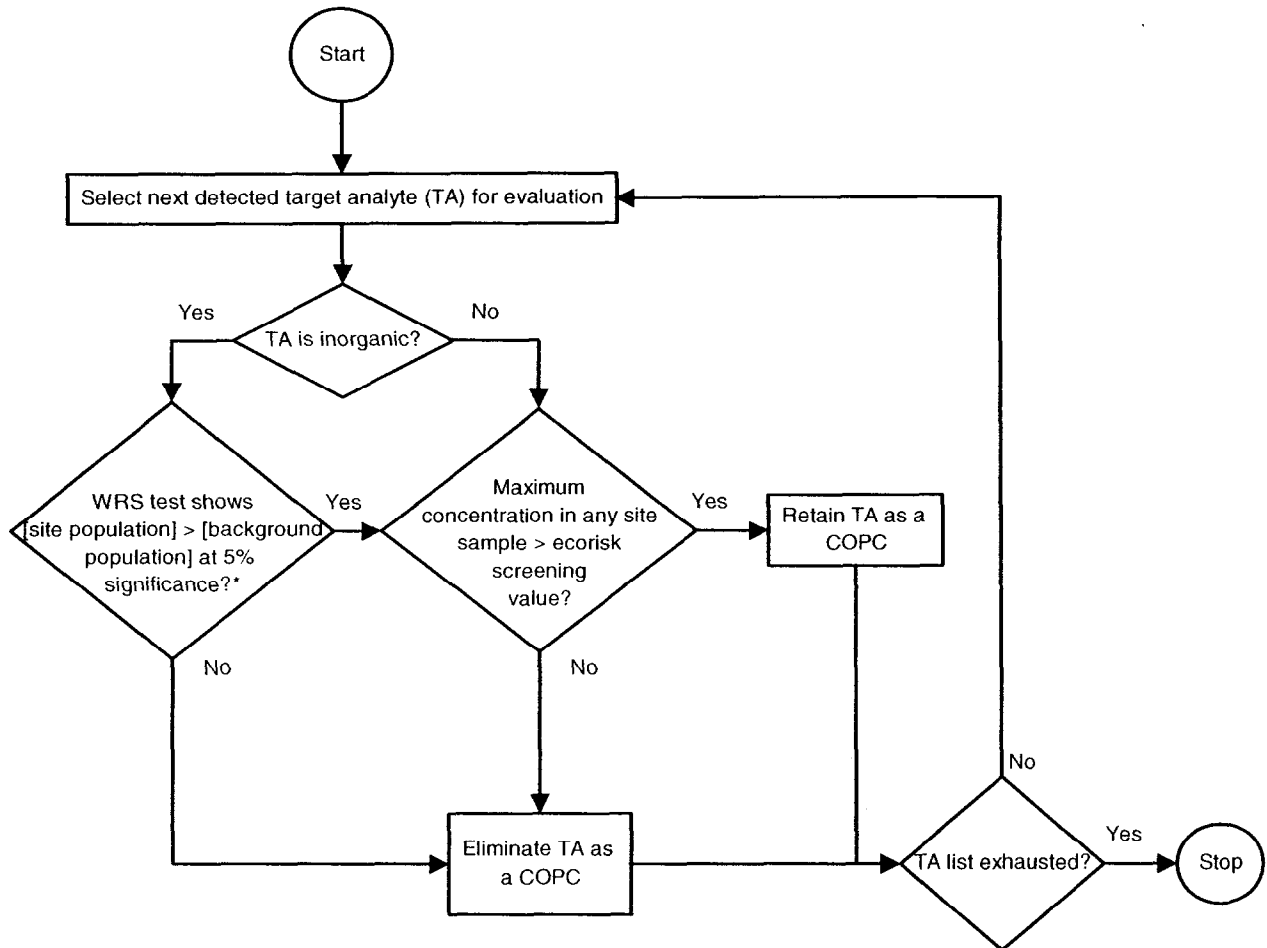
TACO = Tiered Assessment Criteria Objective

WRS = Wilcoxon Rank Sum

\* The background population will be represented by soil data from the project background data set that most closely matches the site soil in terms of parent material, depth and grain size. If multiple soil types are present at the site, multiple background soil types will be used, as necessary, to obtain a reasonable match for each site soil type. If the WRS test proves to be inappropriate (for example, because of a limited number of detectable results), an appropriate statistical test suited to this type of evaluation will be selected.

FIGURE A-8

**SITE 7 AND 22 ECOLOGICAL RISK ASSESSMENT COPC SELECTION FOR SURFACE SOIL  
NTC GREAT LAKES**



COPC = Chemical of potential concern

TACO = Tiered Assessment Criteria Objective

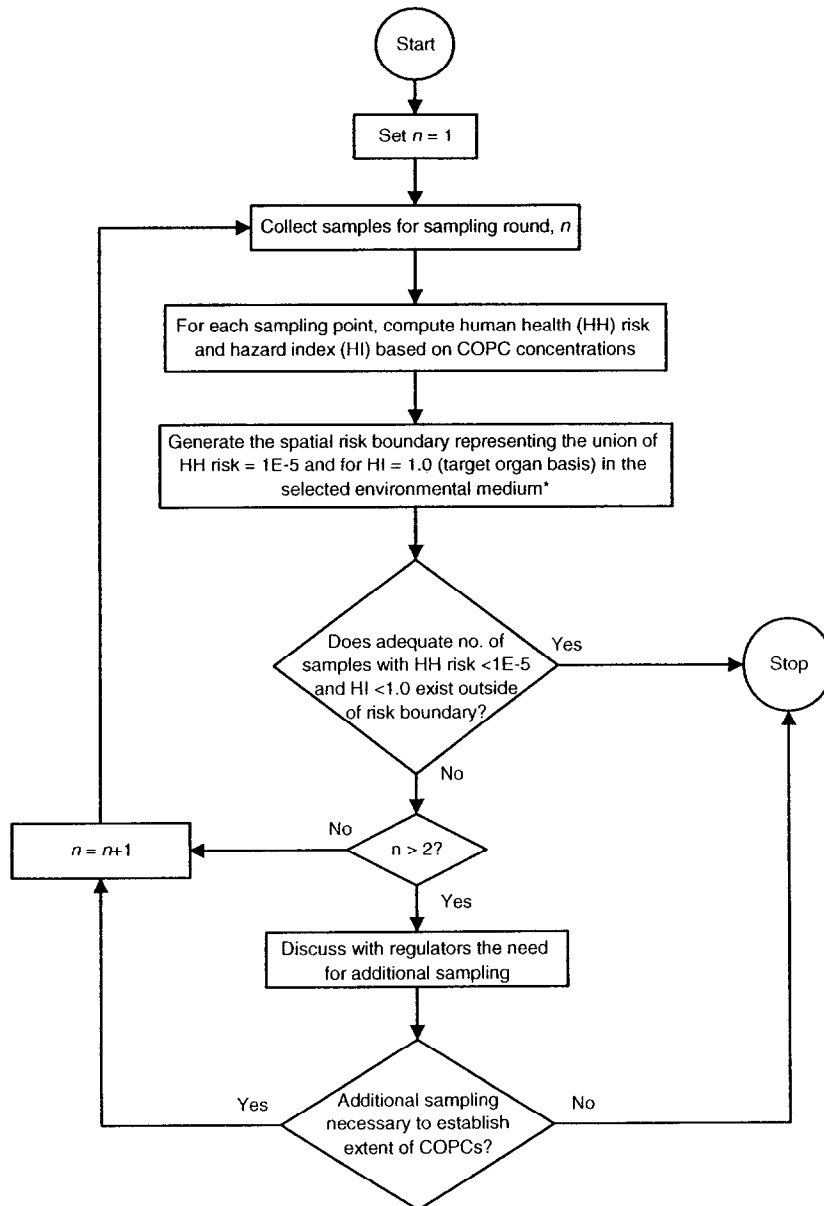
WRS = Wilcoxon Rank Sum

\* The background population will be represented by soil data from project background data set that most closely matches the site soil in terms of parent material, depth and grain size. If multiple soil types are present at the site, multiple background soil types will be used, as necessary, to obtain a reasonable match for each site soil type. If the WRS test proves to be inappropriate (for example, because of a limited number of detectable results), an appropriate statistical test suited to this type of evaluation will be selected.



FIGURE A-9

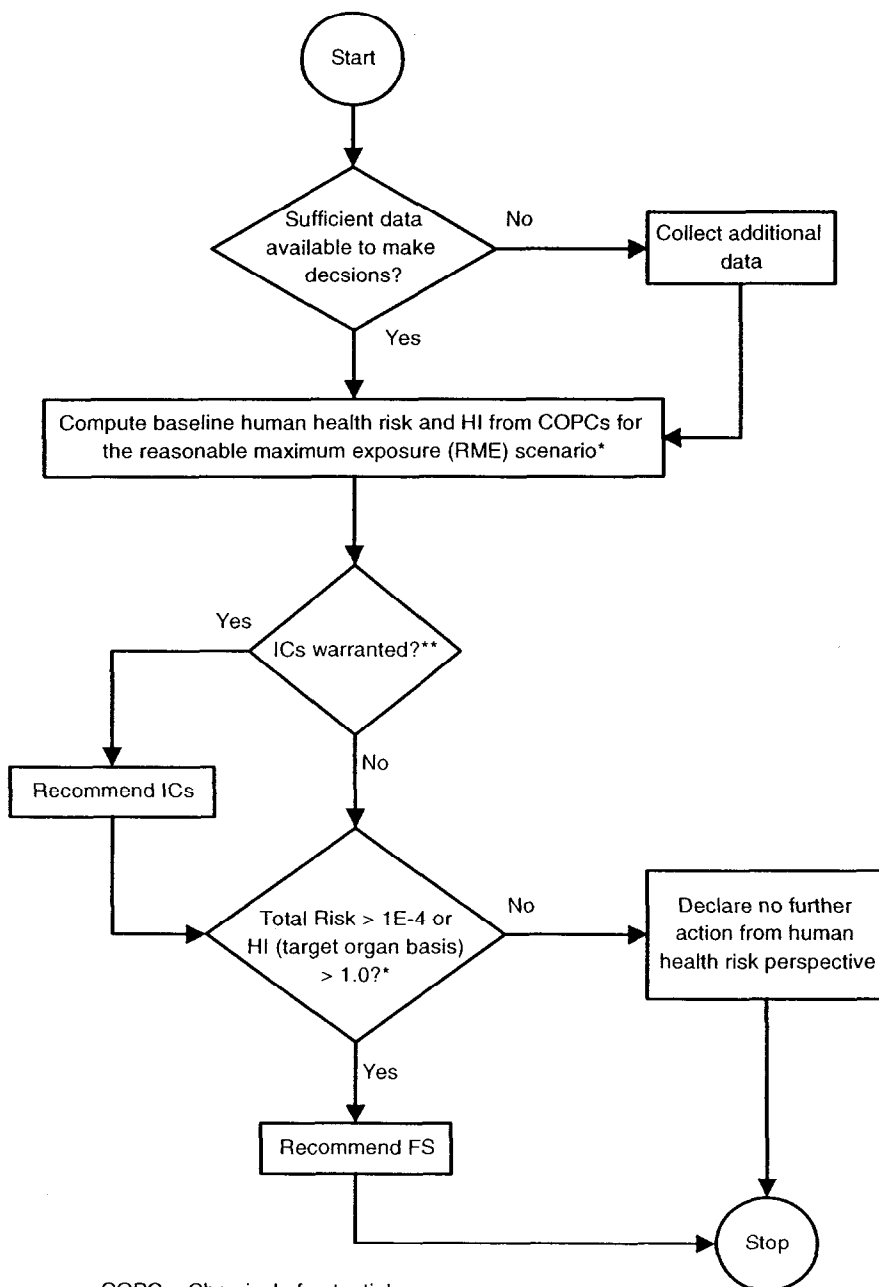
**SITE 7 AND 22 DECISION RULE FOR ESTABLISHING NATURE AND EXTENT OF  
COPCS IN GROUND WATER AND SOILS\***  
NTC GREAT LAKES



\*This decision diagram will be applied to each medium individually

FIGURE A-10

SITE 7 AND 22 BASELINE HUMAN HEALTH RISK ASSESSMENT DECISION FLOW  
NTC GREAT LAKES



COPC = Chemical of potential concern

FS = Feasibility Study

HI = Hazard Index

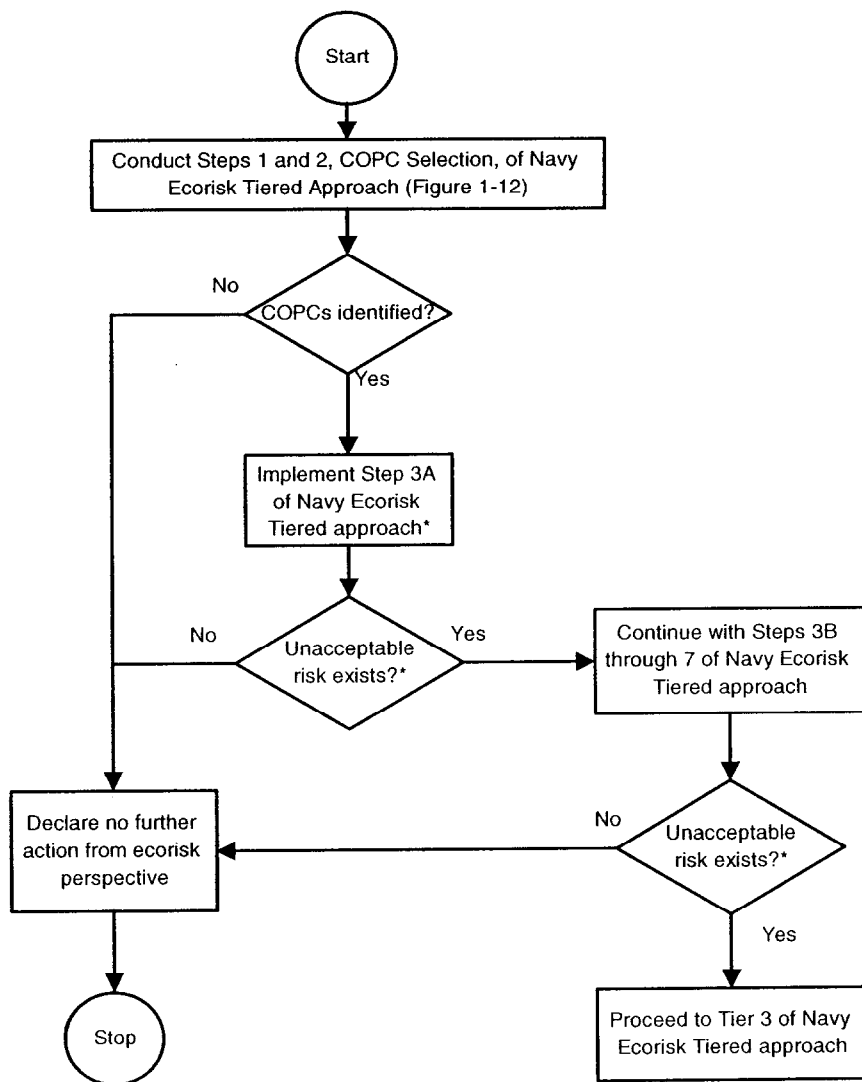
IC = Institutional Controls

\* Computed risk values are the cumulative chemical risks for all media. The computed risk values will be based on the exposure point concentrations explained elsewhere.

\*\*This is could require discussions between Navy and EPA.

FIGURE A-11

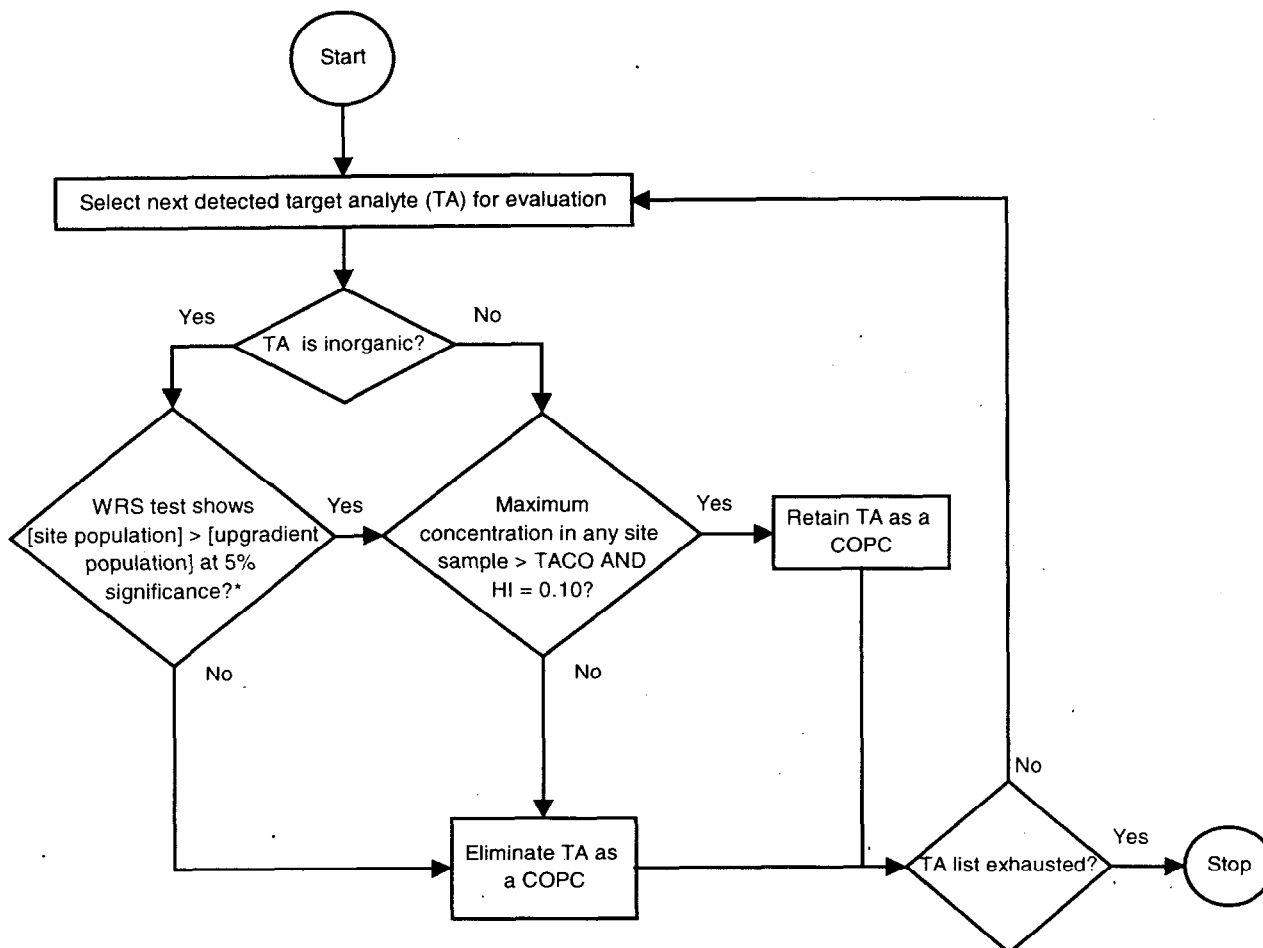
**SITE 7 AND 22 SCREENING-LEVEL AND STEP 3A ECOLOGICAL  
 RISK ASSESSMENT DECISION FLOW  
 NTC GREAT LAKES**



\* This evaluation will include, but not be limited to, consideration of habitat, magnitude of risk-level exceedences, bioavailability of COPCs, and frequency of COPC detection

FIGURE A-12

**SITE 17 HUMAN HEALTH RISK ASSESSMENT COPC SELECTION  
IN SURFACE WATER  
NTC GREAT LAKES**



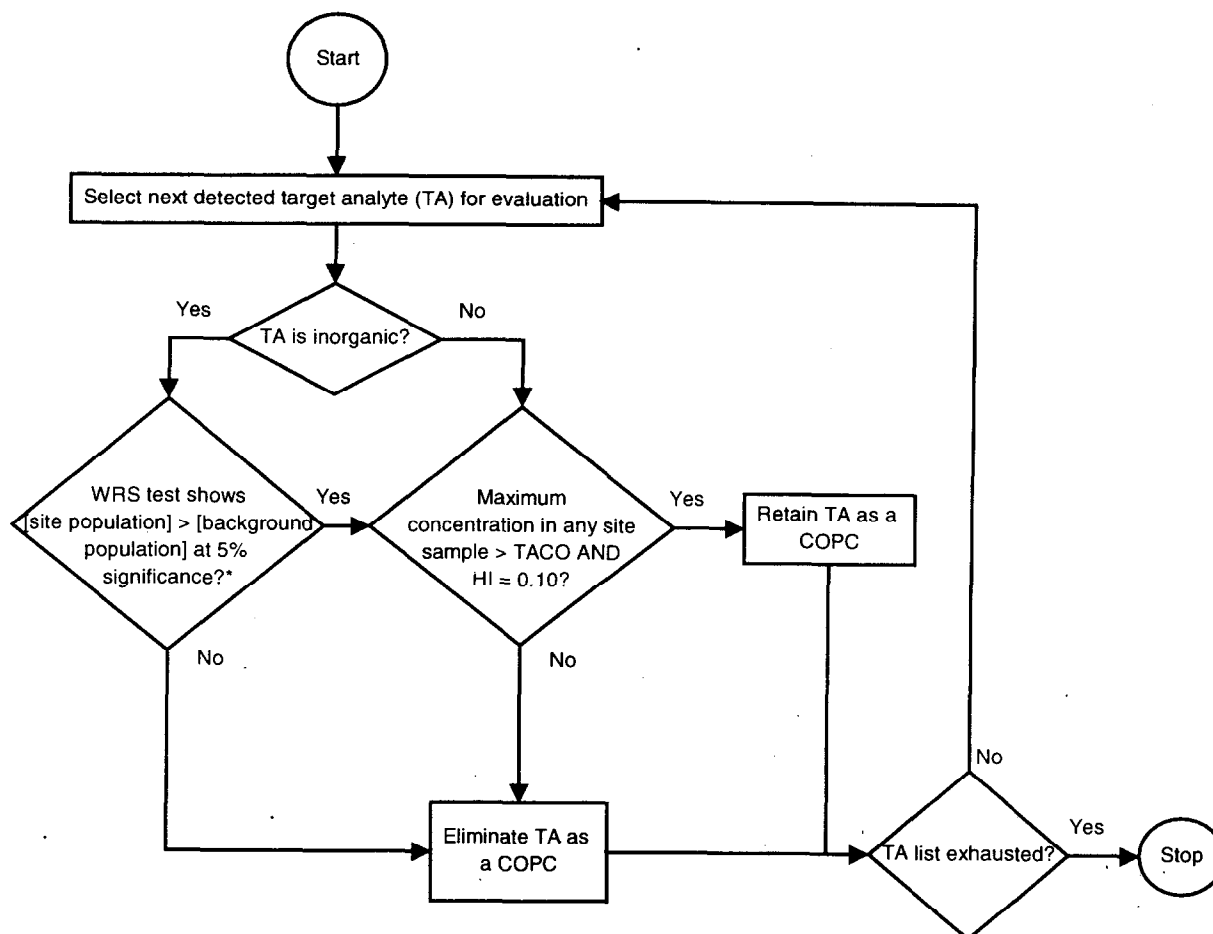
COPC = Chemical of potential concern

TACO = Tiered Assessment Criteria Objective

WRS = Wilcoxon Rank Sum

\* The upgradient population will be represented by samples from upgradient monitoring wells. Sample depths for site and upgradient wells will be matched as closely as practicable to represent corresponding aquifers/depths. If the WRS test proves to be unsuitable for this evaluation (e.g., because of a limited number of detectable results), a more suitable statistical test will be selected.

**FIGURE A-13**  
**SITE 17 HUMAN HEALTH RISK ASSESSMENT COPC SELECTION**  
**IN SEDIMENT**  
**NTC GREAT LAKES**



COPC = Chemical of potential concern

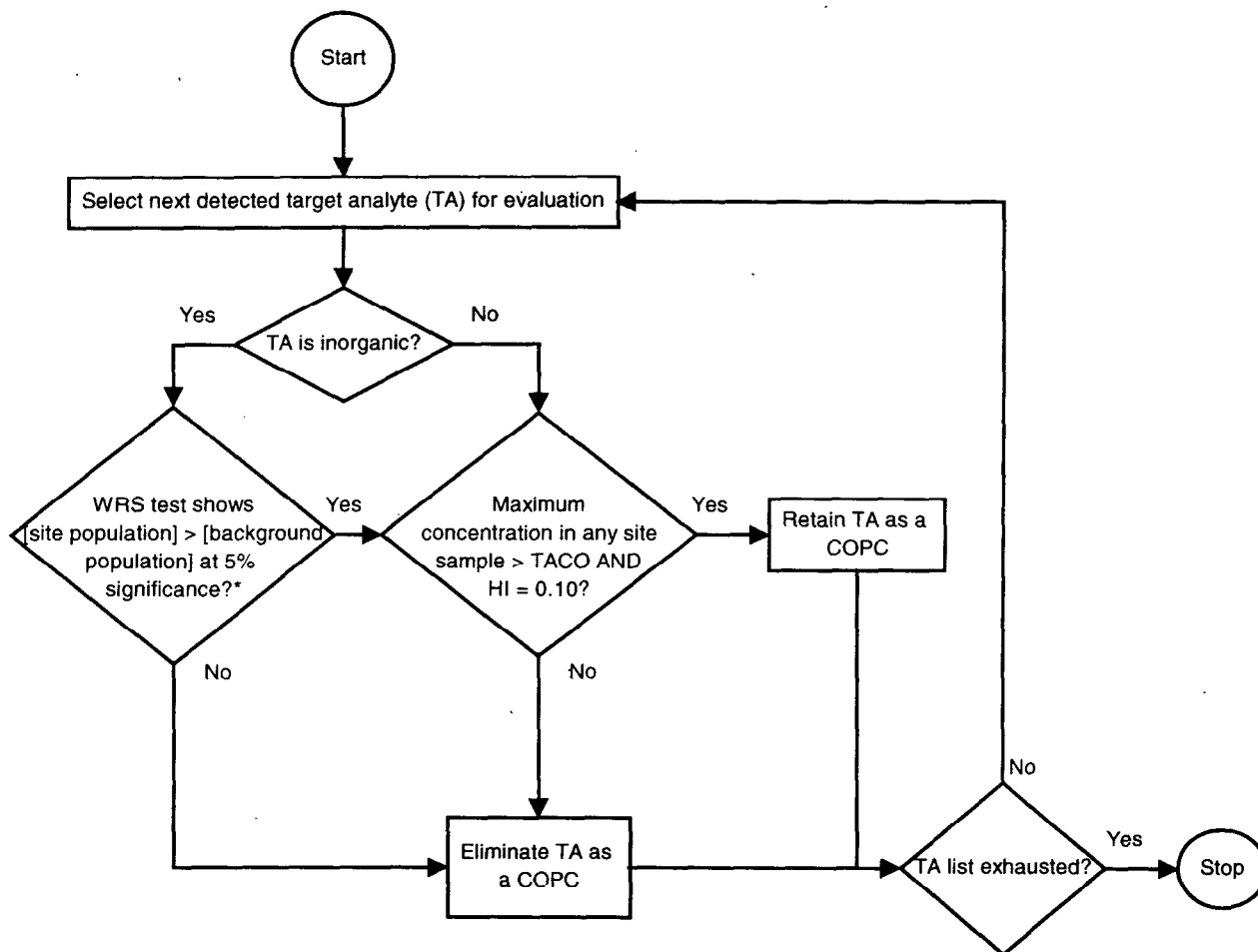
TACO = Tiered Assessment Criteria Objective

WRS = Wilcoxon Rank Sum

\* The background population will be represented by soil data from the project background data set that most closely matches the site soil in terms of parent material, depth and grain size. If multiple soil types are present at the site, multiple background soil types will be used, as necessary, to obtain a reasonable match for each site soil type. If the WRS test proves to be inappropriate for this evaluation (e.g., because of a limited number of detectable results), a more suitable statistical test will be selected.

FIGURE A-14

SITE 17 ECOLOGICAL RISK ASSESSMENT COPC SELECTION FOR SEDIMENT  
NTC GREAT LAKES

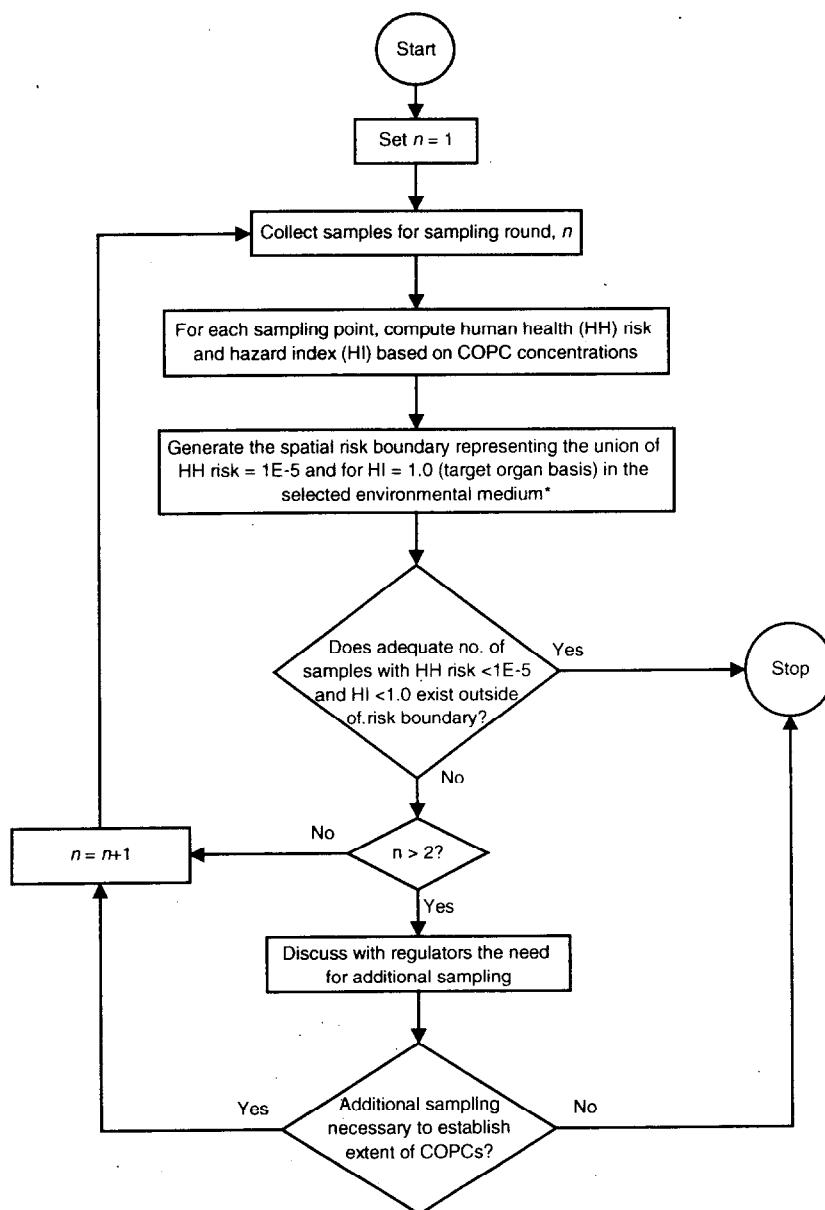


COPC = Chemical of potential concern  
TACO = Tiered Assessment Criteria Objective  
WRS = Wilcoxon Rank Sum

\* The background population will be represented by soil data from the project background data set that most closely matches the site soil in terms of parent material, depth and grain size. If multiple soil types are present at the site, multiple background soil types will be used, as necessary, to obtain a reasonable match for each site soil type. If the WRS test proves to be unsuitable for this evaluation (e.g., because of a limited number of detectable results), a more suitable statistical test will be selected.

FIGURE A-15

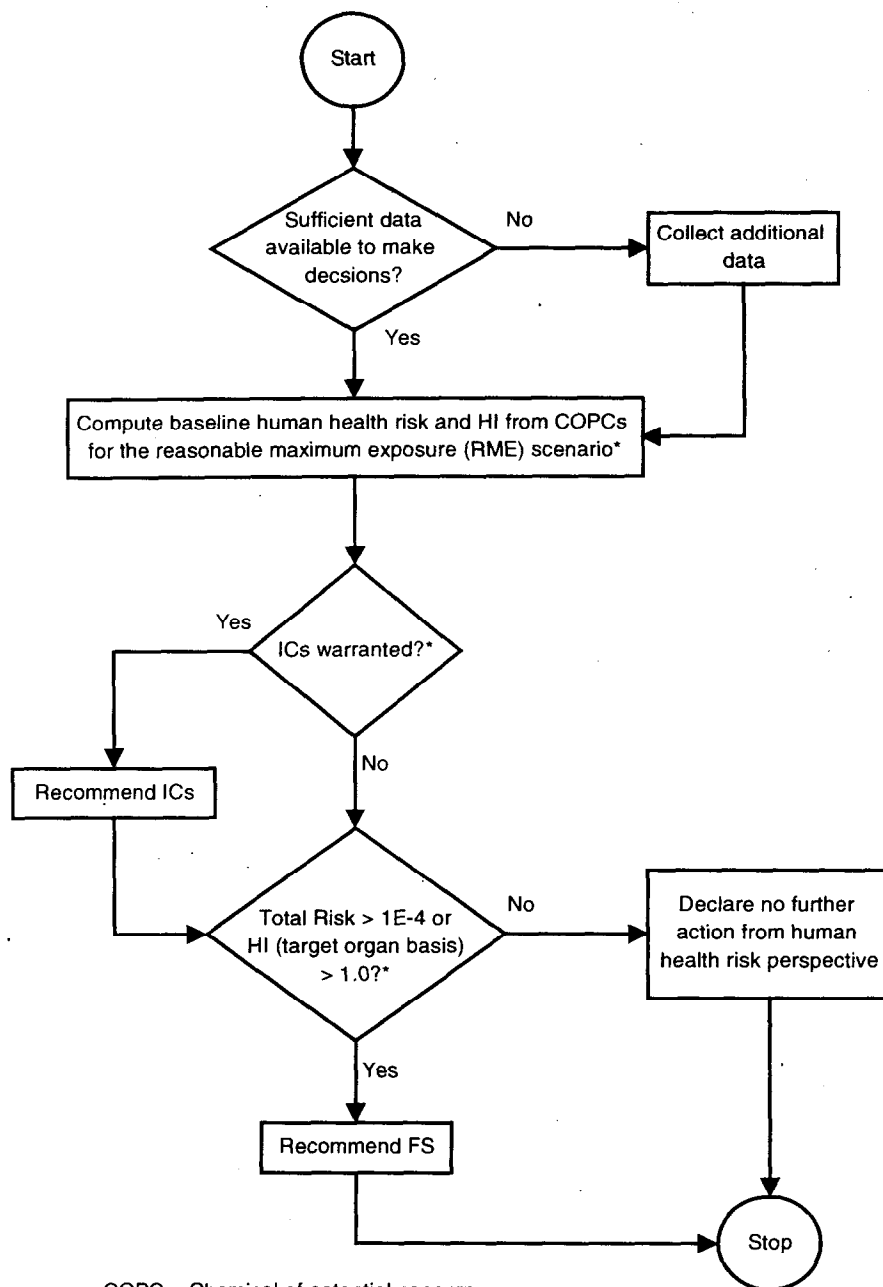
**SITE 17 DECISION RULE FOR ESTABLISHING NATURE AND EXTENT OF  
COPCS \*  
NTC GREAT LAKES**



\*This decision diagram will be applied to each medium individually.

FIGURE A-16

SITE 17 BASELINE HUMAN HEALTH RISK ASSESSMENT DECISION FLOW  
NTC GREAT LAKES



COPC = Chemical of potential concern

FS = Feasibility Study

HI = Hazard Index

IC = Institutional Controls

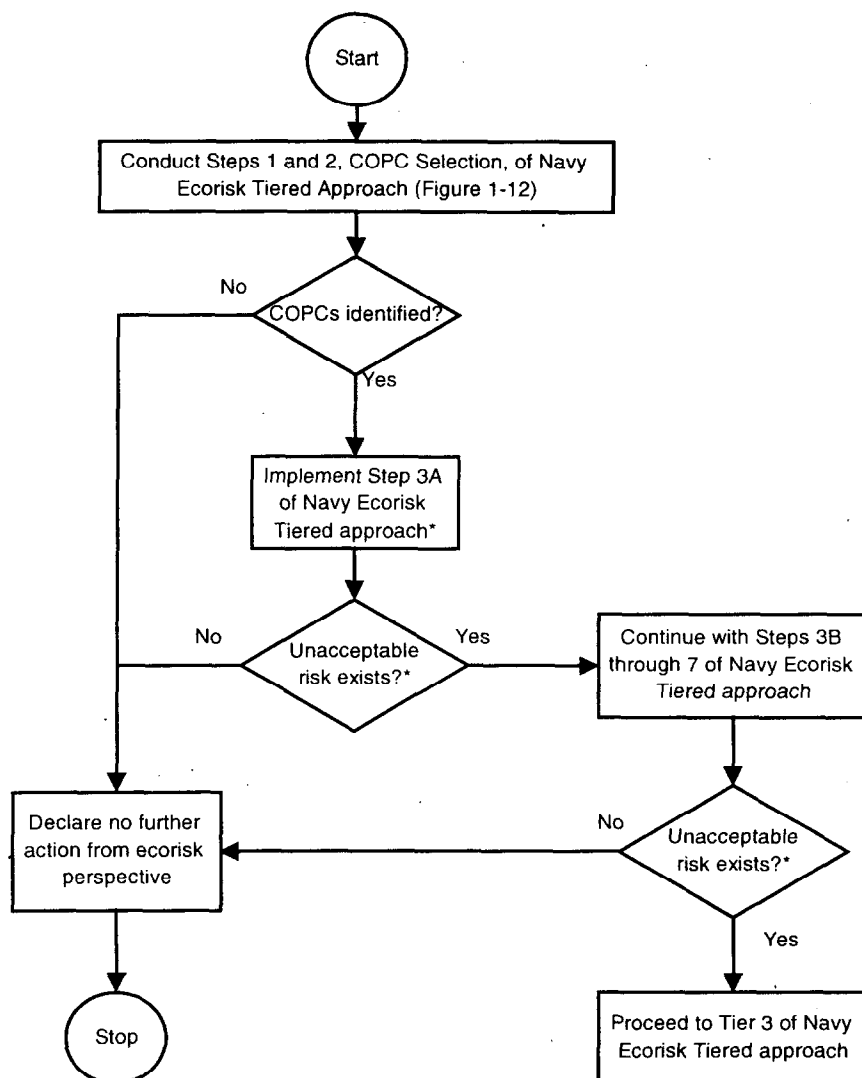
\* Computed risk values are the cumulative chemical risks for all media. The computed risk values will be based on the exposure point concentrations explained elsewhere.

\*\*This could require discussions between Navy and EPA.



FIGURE A-17

**SITE 17 SCREENING LEVEL AND STEP 3A ECOLOGICAL  
RISK ASSESSMENT DECISION FLOW  
NTC GREAT LAKES**



\* This evaluation will include, but not be limited to, consideration of habitat, magnitude of risk-level exceedences, bioavailability of COPCs, and frequency of COPC detection

## 070104/P

A-9-

CTO 0154

## **B. DATA GENERATION AND ACQUISITION**

### **B1 SAMPLING PROCESS DESIGN**

The sampling design is described separately below for Sites 7 and 17.

#### **B1.A Site 7**

Site 7 historical sampling is sparse and site conditions are likely to have changed since the last sampling event. Contaminant release and migration pathways are expected to have created a potential for site contaminants to have migrated. Groundwater could have been impacted by these releases. A judgmental sampling design was used to maximize the potential for bounding the contamination while providing enough coverage of the site to estimate risks. The risk estimates, because they are generally biased toward contaminated areas, are expected to be elevated relative to the actual human risk at the site. Details of the risk scenarios are presented in Appendices I and II.

The sampling locations are presented in Figure B-1. The well locations were selected to provide water level data useful for estimated groundwater flow directions, as well as the nature and extent of contamination and risk to human receptors. Soil sampling locations and depths are consistent with the human receptor exposure scenarios and were selected to estimate contaminant concentrations for establishing the nature and extent of contamination and to estimate human health risk for receptors exposed to surface and subsurface soils. The sample data will be averaged across the site to estimate average exposure to the entire site. An exposure unit covering just Site 7 is a conservatively sized exposure unit for the chosen receptors because it is smaller than a typical residential lot. Small lot sizes are likely to lead to conservative risk estimates because the small lots would not include areas outside the contaminated area which may be less contaminated and to which potential receptors also have access. The use of smaller areas would, therefore, not be representative of the actual exposures likely to be encountered by potential receptors. Furthermore, the residential risk scenario is the most conservative of the human health risk scenarios.

#### **B1.B Site 17**

One objective of this investigation is to establish the nature and extent of contamination. In addition, risks to humans and ecological receptors will be estimated based on the data collected from this site. This site was subdivided into two portions/strata (Pettibone Creek and the Boat Basin) because of differences in known or expected contaminant transport and deposition mechanisms between the two strata. For

example, sediments from Pettibone Creek settle out and accumulate in the Boat Basin over time. Furthermore, interaction of ecological and human receptors with environmental media is expected to be different in these two strata because of the topographical and other physical differences. The human health and ecological risk scenarios are described in detail in Appendices I and II. The sediment sampling locations are presented in Figure B-2. Surface water samples will also be collected and these sampling locations are shown on Figure B-3.

## **B2 SAMPLING METHODS REQUIREMENTS**

### **B2.A Sampling Standard Operating Procedures (SOPs)**

This section of the QAPP describes the field sampling procedures for the field investigations at Site 7 – RTC Silk Screening Shop and Site 17 – Pettibone Creek/Boat Basin.

#### **B2.A.1 Site 7 Surface and Subsurface Soil Sampling**

Seventeen surface soil samples (07SS01 through 07SS17) will be collected at locations from sites shown on Figure B-1. Surface soil samples will be collected from 0 to 1 foot below ground surface (bgs) using Direct Push Technology (DPT), split-spoon sampling techniques, stainless steel hand auger, or a single-use, dedicated plastic trowel. Upon sample retrieval, the samples will be monitored with a Photoionization Detector (PID) and then retained for lithologic and chemical analysis. Samples to be analyzed for volatile organic parameters will be obtained first along the 0.5- to 1-foot soil interval. Samples for volatile organic compound (VOC) analysis will be collected with EnCore samplers. Samples for semi-volatile organic compounds (SVOC) and inorganic parameters (metals, etc.) will be collected from 0- to 1-foot bgs using a disposable plastic trowel. The samples will immediately be placed in a cooler at 4°C. Before samples are obtained, the pertinent ambient conditions and field data will be recorded in the field logbook and on the soil sample log sheet (included in Appendix V). For additional guidance regarding surface soil sampling refer to Appendix V, SOP CTO 154-6. Tables B-1 and B-2 present summaries of soil samples to be collected at Site 7, including numbers and types of QA/QC samples.

If the soil recovery from the first attempt produces an inadequate yield to fill sample containers one of two alternative methods will be used to fill the remaining sample containers. One alternative method would be to offset the sample location a foot and resample the 0- to 1-foot interval. The second method that could be used is to sample the SVOC and inorganic parameters with a disposable trowel, taking care not to include vegetation or gravel in the sample. In either case, the material to be sampled for SVOC and

inorganic chemical analyses will be mixed before being subdivided into separate analyte fractions. This mixing will provide a representative surface soil sample for each sampling location.

Seventeen soil borings will be installed by DPT or Hollow Stem Auger (HSA) methods at Site 7, including:

- The seventeen borings designated 07SB01 through 07SB17 to be located at locations shown on Figure B-1. Their depths will be to 20 feet with one soil boring to 50 feet for lithologic purposes.
- Seven soil borings will be converted to temporary wells after soil samples are collected from the boring. These seven temporary wells will be used to determine approximate groundwater quality and flow direction.
- Three soil samples will be collected from each soil boring as follows:
  - At the ground surface (0 to 1 feet bgs). Samples for volatile organic analyses will be collected from the 0.5- to 1-foot interval and SVOC and inorganic analyses will be collected from the 0- to 1-foot interval.
  - Between 1 foot bgs and depth above saturation, and based on a screening priority, the VOC sample will be collected from the 1-foot interval with the highest PID reading. If no elevated PID readings are observed, the subsurface sample will be collected based on visual observations of staining or non-native soil. If neither of these situations are encountered, the sample will be collected from a randomly selected 1-foot interval (see SOP CTO 154-6).
  - Subsurface soil from 1 foot to depth above saturation will be composited and sampled for SVOC and inorganic analysis.

Subsurface soil samples will be collected from soil borings using direct-push 4-foot core samplers or 2-foot split-spoon samplers, as appropriate. Samples will not be collected at depths greater than 10 feet or below the top of the saturated zone. The subsurface soil sampling will be done in accordance with SOP CTO 154-6, contained in Appendix V. Selection of intervals for sampling volatile organics is based on staining or saturation. The samples obtained from the borehole will be immediately screened with a PID and visually scanned for staining or saturation before collection for lithologic and/or chemical analysis, as appropriate. The subsurface soil sample for SVOC and inorganic laboratory analysis will be collected from a composite of the total length of the boring until groundwater is reached.

Upon sample retrieval, the soil to be analyzed for VOCs will be collected first using EnCore samplers and placed in a cooler of ice. The other soil to be analyzed for other parameters (i.e., SVOCs, metals, etc.) will then be mixed, placed into the required containers, immediately sealed, and placed in a cooler at 4°C. The 4-foot long clear plastic sleeves inside of the direct-push samplers will be cleaned of visual soil and disposed of as trash.

If used, split spoon samplers will be decontaminated between soil sample collections. The Field Geologist will dictate the use of split spoon samplers. The following decontamination steps will be conducted:

- Potable water, phosphate-free detergent wash (scrub if necessary)
- Potable water rinse
- Deionized (DI) water rinse
- Isopropanol (only if oily soil conditions are encountered).
- Deionized water rinse
- Air dry (if possible)
- Wrap in aluminum foil (if not to be used immediately)

Additional guidance and requirements for decontamination are presented in SOP CTO 154-8 contained in Appendix V.

Disposable equipment used for sampling activities shall be decontaminated using detergent wash and potable water rinse, placed in plastic garbage bags, and discarded in dumpsters at NTC Great Lakes.

Field analytical equipment such as pH, conductivity, and temperature probes will be rinsed first with analyte-free water, then with the sample liquid. Water level measurement devices will be rinsed with potable water. The pertinent field data are recorded on a Soil Sample Log Sheet (included in Appendix V) and in the field logbook.

Analytical parameters for surface and subsurface soil samples include the following:

- TCL VOCs (to include ethyl alcohol and ethyl acetate)
- TCL SVOCs
- TAL Metals
- Total Organic Carbon (TOC)

- Toxicity Characteristic Leaching Procedures (TCLP) organics and inorganics
- Grain Size (field and laboratory analysis)

#### **B2.A.2 Site 7 – Borehole Abandonment**

Once a boring is drilled to the desired depth, if it will not be converted to a monitoring well, then it will be backfilled according to SOP CTO 154-6. Borings with standing water will be backfilled with clean pea gravel or limestone chips to 10 feet below the top of the water table. Then, using a tremie pipe, filled from the bottom up to the ground surface with a cement-bentonite slurry. A standard batch of slurry consists of approximately one 94-pound bag of cement, 5 percent by weight (5 pounds) bentonite powder, and 6.5 to 7 gallons of potable water. Dry boreholes will be backfilled with bentonite chips and hydrated per manufacturer specifications; typically using 1 gallon of water per 1 foot of bentonite in an 8-inch hole.

#### **B2.A.3 Site 7 – Temporary Monitoring Well Installation**

Seven temporary monitoring wells will be installed as part of this investigation. These new wells will be screened in the first water-bearing zone, which is anticipated to be 10 to 15 feet deep. The HSA drilling method will be used for the installation of ground water monitoring wells in overburden materials. During the overburden drilling, continuous DPT samples or split-spoon sampling and borehole logging will be performed.

Soil drilling using the HSA method will be accomplished after DPT samples have been obtained using a truck-mounted CME-55 auger rig, or equivalent, of sufficient size and power that will advance augers to the anticipated maximum drilling depth. The total depth of each borehole will be dictated by the depth at which the water table is encountered. After the hollow-stem augers have been advanced to the designated depth below the water table at each borehole location, a 2-inch diameter polyvinyl chloride (PVC) ground water monitoring well will be installed.

Well construction and drilling methods will be performed in accordance with SOUTHDIV Monitoring Well Design, Installation, Construction, and Development Guidelines (SOUTHDIV, 1997). The monitoring wells will be installed in a manner consistent with Illinois Water Well Construction Code (77 Ill. Adm. Code 920) by a water well driller licensed by the State of Illinois.

#### **B2.A.4 Site 7 – Temporary Monitoring Well Construction**

Monitoring wells will be constructed of 2-inch inside diameter (I.D.), Schedule 40 PVC and flush-joint, factory-slotted well screen. Well screens will be approximately 10 feet in length, with exact lengths based

on the geologist's interpretation of the lithology. The well screens will have a slot size of 0.010 inch and will be supplied with a PVC end cap. Five-foot long well screens may be used where a shorter screened interval is desired or where total well depths are less than 10 bgs, based on site conditions determined during the investigation. The numbers, locations, estimated screened intervals, and approximate total well depths at each site are described in Table B-3.

Once the screen and the riser pipe are in place, the annulus of the boring will be backfilled with clean silica sand from the bottom of the boring to 1 to 2 feet above the top of the well screen. A bentonite pellet seal (minimum 2-foot thickness) will be installed and allowed to hydrate per the manufacturer's recommendations. The depths of the backfill materials will be constantly monitored during the installation of the monitoring well using a weighted stainless steel or plastic tape to make sure that no bridging of the sand pack or bentonite occurs during the installation process. Illinois State well installation requirements in Section 920.170 (77 Ill. Adm. Code 920) will be followed for the well installation activities. A well construction log, as presented in Appendix V, will be completed for the wells.

#### **B2.A.5 Site 7 – Temporary Well Development**

The newly installed temporary monitoring wells will be developed no sooner than 24 hours after installation to remove fine material from around the well screen. Wells will be developed by bailing and surging and/or by pumping as determined by the field geologist. Recharge rates will be noted. Measurements of pH, temperature, specific conductance, and turbidity will be collected after each well casing volume and recorded in the field logbook. The wells will be developed until three consecutive readings are within the following criteria: pH +/- 0.1 standard units, temperature +/- 3% degrees Celsius (°C), specific conductance +/- 3% milliSiemens per centimeter (mS/cm), and turbidity less than 10 nephelometric turbidity units (NTU). If water quality parameters do not stabilize after five well volumes have been removed and a nonturbid sample cannot be collected, then the site geologist will document the event, notify the TOM and begin sample collection. The well development will be performed in accordance with SOP CTO 154-7 (Appendix V).

#### **B2.A.6 Site 7 Ground Water Sampling**

Seven ground water samples will be collected from the seven temporary monitoring wells at locations within, upgradient, downgradient, and cross-gradient of the site. The upgradient well to be installed at the western boundary, will be designated 07MW01. The cross-gradient well located at the southern boundary will be designated 07MW04, and the three new downgradient wells at the eastern boundary will be designated 07MW05, 07MW06, and 07MW07. The two source monitoring wells will be designated



07MW02 and 07MW03. The ground water sampling will be conducted in accordance with the requirements of the project-specific Work Plan and in accordance with SOP CTO 154-3, contained in Appendix V.

Tables B-4 and B-5 present summaries of ground water samples to be collected at Site 7, including numbers of QA/QC samples. Fixed-based laboratory analytical parameters for ground water samples at Site 7 include the following:

- TCL VOCs (to include ethyl alcohol and ethyl acetate)
- TCL SVOCs
- TAL Metals
- Total Organic Carbon (TOC)

Filtered ground water samples will be collected for metals analysis only if a turbidity of less than 10 NTUs cannot be achieved during stabilization.

Field parameters to be measured for ground water samples at Site 7 include:

- pH
- Turbidity
- Specific conductance
- Dissolved Oxygen
- Hydraulic Conductivity
- Temperature
- Oxidation-Reduction Potential (ORP)

#### **B2.A.7 Site 7 –Water Level Event**

Water level measurements will be obtained from the temporary monitoring wells with an electronic water-level indicator (M-scope) or other approved instrument, using the top of the well riser as the reference point for determining depths to water. The measurements will be taken in accordance with Appendix V, SOP CTO 154-1. A notch or marking will be used at the top of the PVC riser pipe to obtain consistent measurements between measuring events. If a notch, mark, or surveyed reference point is not visible on the top of casing, a mark will be made. Water-level measurements will be recorded to the nearest 0.01-foot in the appropriate field log book and on a ground water-level measurement form.

#### **B2.A.8 Site 7 – Slug Tests**

Slug tests will be performed in a minimum of three monitoring wells to determine the hydraulic characteristics of the formations in the immediate vicinity of these wells. Although slug tests typically require electronic data logging equipment, the tests do not require pumping and are therefore applicable in low-yield aquifers or locations where contaminated water disposal is prohibitively expensive. The slug test will be conducted to meet the requirements of this QAPP and Appendix V, SOP CTO 154-16.

Prior to performing the slug test, the static water level will be recorded along with the well construction details on a Hydraulic Conductivity Testing Data Sheet (see Appendix V). Both rising-head and falling-head tests will be performed either inserting a solid slug into the well to raise water levels and then measuring the rate of decline in water level (falling-head test), or by removing a slug of water and measuring the rate of rise in the water level back to equilibrium (rising-head test). The changes in water level are induced as quickly as possible, because the analysis assumes an instantaneous change in head. Falling-head tests are not performed where water level is within the screened interval (i.e., below the top of the well screen). In addition, as slug tests are very sensitive to borehole skin effects, the well must be developed properly prior to testing to obtain accurate data. A minimum of one falling-head and one rising-head test will be conducted at each of the designated wells if conditions permit.

Slug test data are collected using an electronic data logger with a pressure transducer and manually checked using an electronic water-level indicator (M-scope). To facilitate data graphing, the loggers are programmed to record measurements on a logarithmic time scale. It is ideal to record water-level data to at least 90 percent recovery in the well before terminating the test but not necessary. The resulting plot of time/head ratio on semi-log paper should approximate a straight line. The test should be rerun if data scatter is excessive or if the straight-line approximation is not obtained. This decision will be determined by the Field Geologist or Field Technician performing the test.

Raw data from the loggers or field records are used to calculate values of hydraulic conductivity for the aquifer in the immediate vicinity of the well. The data are analyzed using one or more of the following three methods (other methods have been developed and may be used where applicable):

- Hvorslev Method – Simple straight-line method for partially to fully penetrating well screens
- Bouwer and Rice Method – Rigorous straight-line method for complex well geometries
- Cooper, et al. Method – Type-curve method for low-permeability aquifers

The above methods are analyzed relatively simply by hand. However, the data may also be analyzed using various commercially available computer programs.

#### **B2.A.9 Site 7 – Temporary Well Abandonment**

Abandoned temporary monitoring wells shall be sealed within 30 days after they are abandoned. The temporary wells will be disinfected by introducing a sufficient amount of chloride to produce 100 parts per million of chlorine in the water in the well. They shall be sealed by placing the sealing materials from the bottom of the well to the surface by methods that will not avoid segregation or dilution of material in accordance with the following requirements (the following descriptions are modified from 24 Ill. Reg. 11934 as amended, effective August 1, 2000):

1. Non-creviced, consolidated formations. Wells extending into non-creviced sandstone, or other water-bearing consolidated formations shall be sealed by filling the well with disinfected clean pea gravel or limestone chips to within 10 feet below the top of the water-bearing formation or to within 10 feet of the bottom of the casing, whichever is shallower. Neat cement grout or any bentonite product manufactured for water-well sealing shall be placed for a minimum of 20 feet above this point. The upper part of the well to where the well casing is removed shall be sealed by neat cement grout or any bentonite product manufactured for water well sealing. Concrete or cement may be used for such sealing, provided the upper part of the well is dry.
2. Unconsolidated formations. If the water-bearing formation consists of coarse gravel and producing wells are located nearby, the well shall be sealed by filling with disinfected clean pea gravel or limestone chips to 10 feet below the top of water bearing formation. Neat cement grout or any bentonite product manufactured for water-well sealing shall be placed for a minimum of 20 feet above this point. The upper part of the well to where the well casing is removed shall be sealed by neat cement grout or any bentonite product manufactured for water well sealing. Concrete or cement may be used for such sealing, provided the upper part of the well is dry. Abandoned dug and bored wells will be sealed by using one of the following methods:
  - A. Filling with disinfected clean pea gravel or limestone chips to within 20 feet below the top of the casing. The upper part of the well to where the well casing is removed will be sealed for a minimum of 20 feet by filling with neat cement grout, any bentonite product manufactured for water-well sealing, or an impervious material such as clay. Concrete or cement may be used for such sealing, provided the upper part of the well is dry.

- B. Placing a one foot layer of any bentonite product manufactured for water-well sealing at the bottom of the well followed by alternating layers of agricultural limestone (limestone fines) and any bentonite product manufactured for water-well sealing. The alternating layers of agricultural lime shall be five to seven feet thick and the alternating layers of any bentonite product manufactured for water well sealing shall be six inches thick. The uppermost or top layer shall be agricultural lime.
  - C. Completely filling the well with concrete, cement grout, or impervious material such as clay.
3. Non-producing well. If a water well is drilled and a water bearing formation is not located, the water well shall be filled with clay, or neat cement containing bentonite, aquajel or similar materials from 2% to 6% by weight, or pure bentonite in any form by the water well driller not more than 10 calendar days after the well has been drilled.

Notification:

- 1. The Illinois Department of Health or approved unit of local government shall be notified by telephone or in writing at least 48 hours prior to beginning work to seal a water well or monitoring well.
- 2. When a water, boring or monitoring well is sealed, a sealing form will be submitted to the Illinois Department of Health by the individual performing the sealing not more than 30 days after the well is sealed. The following information shall be submitted on the form provided by the Department (24 Ill. Reg. 11934 as amended, effective August 1, 2000):
  - A. the date the water, boring or monitoring well was drilled;
  - B. depth and diameter of the water, boring or monitoring well;
  - C. location of the water, boring or monitoring well;
  - D. type of sealing method used;
  - E. original water well permit number if available;
  - F. date the water, boring or monitoring well was sealed;
  - G. type of water well (bored, dug, driven or drilled);
  - H. whether the formation is clear of obstructions;
  - I. casing record (explanation of the required removal); and
  - J. water well driller's license number and name.

#### **B2.A.10 Site 17 – Surface Water and Sediment Sampling**

Six non-collocated surface water samples will be collected at Site 17 including:

- Two locations, designated 17SW01 through 17SW02, in Pettibone Creek
- Two locations, designated 17SW03 through 17SW04, in the South Branch of Pettibone Creek
- Two locations, designated 17SW05 through 17SW06, in the Boat Basin.

Surface water samples will be collected from the locations shown on Figure B-3 and described in Table B-6, including numbers of QA/QC samples (Table B-7), and submitted to a fixed-base laboratory. The objective of this section is to describe the proper use of sampling equipment and proper techniques for sample collection. The surface water sampling will meet the requirements of the project Work Plan and QAPP and Appendix V, SOP CTO 154-4.

At each sampling location, surface water samples will be obtained before sediment samples, at midstream, just below the water surface. For VOCs, sample containers will be filled directly from the surface water body using no transfer bottle. For other parameters, the water will be sampled with a clean stainless-steel pitcher, jar, or extra unpreserved clean glass sample bottle supplied by the laboratory. Filtered and unfiltered surface water will be collected for metals analysis. For filtration of surface water samples, unpreserved polyethylene bottles will be used to transfer samples. Filtration procedures for the filtered surface water samples are provided in SOP CTO 154-4 in Appendix V. Immediately after collection, samples will be sealed and placed in a cooler at 4°C.

A sampling location description form (Appendix V) will be completed for each sampling point, either during an initial survey or at the time of sample collection. However, field measurements will be obtained at the time of sampling, including DO, ORP, pH, specific conductance, temperature, and turbidity. Suitable calibrated meters will be used for pH and temperature, but DO will be measured with an instrument with a polarographic probe.

Fifty-six non-collocated sediment locations will be sampled at Site 17 including:

- Forty-four locations, designated 17SD01 through 17SD44, in Pettibone Creek, the South Branch of Pettibone Creek, or Pettibone tributaries. Each location will be sampled at 0- to 4-centimeters (cm) deep and 16 locations will have an additional sample collected at the 1-foot depth interval.

- Twelve locations, designated 17SD45 through 17SD56, within the site boundaries of the Boat Basin. Each location will be sampled at four intervals, 0- to 4-cm, 4-cm to 3-feet, 3- to 6-feet, and 6- to 10-feet using DPT methods.

After surface water samples have been collected, sediment will be sampled at the locations shown on Figure B-2. Some sediment samples will be collected in depositional areas. Depositional areas have slowly moving water and predominately fine soil particles. Sediment samples will be collected from the surface (0- to 4-cm) at the sample locations. Depth samples (at 1-foot bgs) will be collected in depositional areas. Any sampler is suitable, but one that can be decontaminated and that does not disturb the surface fines when sampling is preferred. Inert pebbles and organic detritus will be removed from the sample by hand before the sample bottle is sealed and shipped to the laboratory.

Sediment samples obtained in the Boat Basin will be collected from 0- to 10-feet using DPT methods similar to the methods used for sampling subsurface soils. Samples for VOC analysis will be collected first and immediately sealed. Immediately after collection, the samples will be placed in a cooler at 4°C. Refer to Section B2.A.1 and Appendix V, SOP CTO 154-6 for further detail on sediment sampling at depths greater than 4 inches. The sediment sampling will meet the requirements of the project FSP and SOP CTO 154-5, contained in Appendix V. Inert pebbles and organic detritus will be removed from the sample by hand before the sample bottle is sealed and shipped to the laboratory. Tables B-8 and B-9 present summaries of sediment samples to be collected at Site 17, including numbers and types of QA/QC samples.

Fixed-base laboratory parameters to be analyzed for surface water include:

- TCL VOCs
- TCL SVOCs
- TAL Metals (total and dissolved)
- TCL Pesticides
- TCL PCBs

Field parameters to be measured for surface water samples at Site 17 include:

- pH
- Turbidity
- Specific conductance

- Dissolved Oxygen
- Hydraulic Conductivity
- Temperature
- Oxidation-Reduction Potential (ORP)

Fixed-base laboratory parameters to be analyzed for sediment samples include:

- TAL Metals (total and dissolved for surface water samples)
- TCL Pesticides
- TCL PCBs
- PAHs by SW-846, Method 8310
- Total Organic Carbon (TOC)
- AVS / SEM
- Grain Size
- pH
- Toxicity Characteristic Leaching Procedure (TCLP) organics and inorganics

Grain size will also be determined in the field for sediment samples.

#### **B2.A.11 Surveying**

The location of the new temporary monitoring wells, soil borings, surface soil locations, surface water, and sediment sample locations associated with this sampling event will be surveyed. The top of the riser pipe (where the uncapped well riser is notched), the top of the protective casing, and the ground surface elevation at each monitoring well location will be surveyed to within 0.01-foot vertical accuracy. For the other locations, the ground surface elevation will be surveyed to the nearest 0.10-foot. Vertical elevations will be referenced to the 1988 North American Vertical Datum (NAVD88). Existing survey monuments around NTC Great Lakes will be used as reference points. Horizontal locations of samples, borings, and wells will be surveyed to Illinois State Plane coordinates within the nearest 0.10-foot and referenced to the 1983 North American Datum (NAD83).

#### **B2.A.12 Investigation Derived Waste (IDW) Handling**

Field investigations may generate six types of potentially contaminated residues: personal protective equipment (PPE), drill rig decontamination fluids, sampling equipment decontamination fluids, DPT plastic sleeves, development and purged groundwater, and soil cuttings. Based on the activities and types of

contaminants present, none of the residues are expected to represent a significant risk to human health or the environment if properly managed. Planned management of each residue is provided in the following.

PPE - PPE will be double bagged and placed in NTC Great Lakes trash receptacles (dumpsters).

Drill Rig Decontamination Fluids - Drill rig decontamination fluids will be containerized in U.S. Department of Transportation (DOT) approved (Specification 17-C/H), 55-gallon drums and staged on wooden pallets in an area established by TtNUS personnel and the Navy. The drums will be sealed and labeled with drum contents, well/boring number, and date. One composite sample will be collected and analyzed to determine if the material is hazardous. The investigation derived waste (IDW) sampling will follow SOP CTO 154-4 or SOP CTO 154-5 (Appendix V), depending on the media encountered. Based on the laboratory results of the analysis, a determination will be made whether offsite disposal and/or treatment are required. This decision will be made by a TtNUS representative and PWC Great Lakes. Factors to be considered will include disposal costs, additional sampling and analysis costs for waste characterization, schedule and other factors that are important at the time of making the decision. An IDW contractor will be selected, as necessary, for the waste disposal. If IDW materials are shown to be hazardous, TtNUS will arrange for proper removal and disposal of the drummed wastes, although Navy representatives must sign the necessary manifest documentation.

Sampling Equipment Decontamination Fluids - Equipment decontamination fluids will be containerized and handled in the same manner as the drill rig decontamination fluids.

DPT Plastic Sleeves - The sample sleeves will be cleaned of visual soil and disposed as trash.

Purge Water/Development Water - Purge water and development liquids will be containerized in DOT approved (Specification 17-C/H), 55-gallon drums and staged on wooden pallets in an area established by TtNUS personnel and the Navy. The drums will be sealed and labeled with drum contents, well/boring number, and date. One composite sample will be collected and analyzed to determine if the material is hazardous. Based on the results of the analyses, a determination will be made whether offsite disposal and/or treatment are required. If IDW materials are shown to be hazardous, TtNUS will arrange for proper removal and disposal of the drummed wastes, although Navy representatives must sign the necessary manifest documentation.

Drill Cuttings - Soil cuttings will be containerized and handled in the same manner as the drill rig decontamination fluids. One composite sample will be collected using a disposable trowel and analyzed



to determine if the soil is hazardous. Based on the results of the analyses, a determination will be made whether offsite disposal and/or treatment are required. If IDW materials are determined to be hazardous, TtNUS will arrange for proper removal and disposal of the drummed wastes, although Navy representatives must sign the necessary manifest documentation.

#### **B2.B Cleaning and Decontamination of Equipment/Sample Containers**

The equipment used to collect soil, sediment, and ground water samples will be decontaminated in accordance with SOP CTO154-8. The decontamination fluids will be placed in 55-gallon drums and stored at a Navy-approved location where it will be analyzed prior to disposal (see SOP CTO154-8 and Section B.2, A.12). Sample containers (i.e. jars and bottles) will meet Ichem 300 cleanliness standards.

#### **B2.C Field Equipment Maintenance**

Various instruments will be required for field measurements during this investigation and include the following:

- Multi-parameter water quality meter (DO, specific conductance, temperature, pH, and ORP)
- PID
- Electronic water level meter
- LaMotte turbidity meter

The water quality meter and PID will be calibrated in accordance with the corresponding SOP. Calibration of each instrument will be documented on a separate Equipment Calibration Log Form in SOP CTO 156-10 (Appendix V). During calibration, an appropriate maintenance check will be performed on each piece of equipment. The maintenance checks are described in the appropriate SOPs or the manufacturer's instructions. If an instrument can not be made to meet performance specifications during operation, the instrument will be tagged out of service until the instrument is demonstrated to be performing within specifications. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have a negative impact on the instrument's performance, the instrument will be removed from service until the defective parts are repaired or replaced. If the instrument cannot be repaired, a replacement will be procured from the supplier.

The electronic water-level meters will be calibrated prior to field use and periodically at the discretion of the FOL. They will be calibrated by comparison of meter markings with a steel tape measure. This calibration will be documented in the FOLs site logbook.

The Lamotte Turbidity Meter will be calibrated prior to field use. It will be calibrated by comparison to manufacturer's turbidity blanks. Calibration of this instrument will be documented on a separate Equipment Calibration Log Form in SOP CTO 156-10 (Appendix V).

#### **B2.D      Inspection and Acceptance Requirements for Supplies/Sample Containers**

Sample containers and bottles will be ordered from STC Laboratory prior to the start of the field work. The sample containers (i.e. jars and bottles) from the laboratory will meet Ichem 300 cleanliness standards.

The laboratory will send the bottles to the site using a public courier. Copies of the Express Mail air bills should be retained by the laboratory for tracking purposes, if needed, and for communications with the FOL. Air bills will be retained for the Permanent Record File. The FOL will check the supplies and sample containers upon receipt. Concerns with the supplies or sample container will be communicated to the laboratory for corrective action.

The laboratory will add preservatives to the sample bottles prior to shipping the bottles to the site. The preservatives placed in the sample bottles will be certified free of analytes being tested in the samples.

### **B3            SAMPLE HANDLING AND CUSTODY REQUIREMENTS**

This section of the QAPP identifies the procedures for storing and transferring collected samples. Responsibilities of TtNUS field members are discussed below.

#### **B3.A      Sampling Handling**

The following subsections describe precautions taken to make certain sample integrity is maintained throughout the sample collection and shipping processes. Each sample will be divided among several containers. Each container of a particular sample will be specific to the analysis of one or more analyte groups (fractions). Sample collection follows a logical sequence to make sure that the more volatile components of samples are not lost or that losses are minimized during sample handling. For example, samples for VOCs must be collected first and are containerized immediately after collection to prevent or minimize losses from volatilizations. Samples for VOC analyses must be handled in a way that minimizes agitation or disturbance, again to prevent loss of VOCs. Aqueous VOC samples must not have air bubbles in them after containerization. In general, sample fractions will be containerized in the following sequence:

- VOCs
- SVOCs
- Other organic analytes
- Non-volatile inorganic analyses

Sample nomenclature is governed by SOP CTO 154-9 (Appendix V). Samples will be shipped in coolers to the analytical laboratory. Samples will be associated into sample delivery groups (SDGs) of up to 20 samples per SDG. The samples will be shipped via air courier (e.g. Federal Express or Airborne Express). An SDG is compiled in the chronological sequence in which the samples are received at the laboratory over a period of up to 14 days. Additional details concerning various aspects of sample handling are addressed below.

#### **B3.A.1 Sample Preservation**

Preservation requirements for soil and sediment samples for each of the analytes of interest are provided in Table B-10. The soil and sediment samples require only to be cooled to  $4 \pm 2^{\circ}\text{C}$ ; no chemical preservatives are necessary. Sample bottles for aqueous samples will contain the proper amounts and types of preservatives prior to being shipped from NTC Great Lakes (Table B-10). The preservatives placed in the sample bottles will be certified free of analytes being tested in the samples. The samples will be promptly chilled with ice to  $4 \pm 2^{\circ}\text{C}$  and packaged in an insulated cooler. Each cooler will include a temperature blank. Ice will be sealed in containers to prevent water leakage. Samples will not be frozen.

#### **B3.A.2 Sample Labeling**

Sample labels are typically printed in advance of the field effort. Before samples are packaged, the sample labels will be checked to make sure that the information on the label is complete and correct (see SOP CTO154-9) in Appendix V. This information should also be checked against the information on the sample collection log sheet and the chain-of-custody form. Sample tags identified in the U.S. EPA Region 5 Instructions on the Preparation of a Superfund Division QAPP (U.S. EPA 2000C) will not be used for this sampling event.

#### **B3.A.3 Sample Packaging**

Each sample container will be placed in a zip-lock bag to prevent cross-contamination or leakage. The zip-lock bag will be placed in a bubble-wrap sleeve to protect it from breakage and cross-contamination.

Only shipping containers that meet minimum packaging requirements of 49 CFR 174 for safe shipment will be used. Cubed ice will be placed in plastic bags and placed around and between the samples in sufficient quantity to chill the samples to  $4 \pm 2$  °C during transport to the analytical laboratory.

The completed field COC document will be signed, placed in a sealed plastic envelope, and taped to the top inside cover of the shipping container (see SOP CTO154-11, Appendix V). SOP CTO154-11 provides a detailed description of sample handling, packaging, and shipping procedures required for this project. The FOL will be responsible for completion of the following forms:

- Sample Labels
- COC Forms
- Custody Seals for Coolers
- Shipping Labels for Coolers
- Express Mail Air Bills

#### **B3.A.4 Sample Shipping**

Shipping containers (i.e., coolers) will be sealed with nylon strapping tape in at least two places, and custody seals will be signed, dated, and affixed in a manner that will allow the receiver to identify tampering that may have occurred during transport to the laboratory (see SOPs CTO154-10 and 11, Appendix V).

Shipment will be made by a public courier at the next scheduled pickup following completion of sample collection. Copies of the Express Mail air bills should be retained by the FOL for tracking purposes, if needed, and for communications with the laboratory. Air bills will be retained for the Permanent Record File.

#### **B3.B Sample Custody**

Custody of samples must be maintained and documented as per SOP CTO154-10, beginning with the collection of samples in the field. Documented sample custody is one of several factors necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance, and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including original laboratory reports and purge files, are maintained under document control in a secure area. A sample or evidence file is under custody when any one of the following conditions is satisfied:

- The item is in the actual physical possession of an authorized person
- The item is in view of the person after being in his or her possession
- The item was placed in a secure area to prevent tampering
- The item is in a designated and identified secure area with access restricted to authorized personnel only

The COC form is a multi-part, standardized form used to summarize and document pertinent sample information such as sample identification and type, sample matrix, date and time of collection, preservation, and requested analyses. Furthermore, through the sequential signatures of various sample custodians (e.g., sampler, airbill number, laboratory sample custodian), the COC form documents sample custody and tracking.

Compliance with laboratory custody procedures will make certain that sample integrity is not compromised from the time of receipt at the laboratory until final data are reported to TtNUS. This requires that the laboratory control sample handling and storage conditions and circumstances. Custody procedures apply to environmental and associated field QC samples obtained as part of the data collection system.

### **B3.B.1 Field Custody Procedures**

The FOL (or designee) is responsible for the care and custody of the samples collected until they are relinquished to the laboratory or entrusted to a commercial courier. Together, field logbooks and sample documentation, including COC forms, provide a record that should allow a technically qualified individual to reconstruct significant field activities without resorting to memory. COC forms are completed to the fullest extent possible for each sample cooler used for shipment. The forms are legibly completed with waterproof ink, and are signed and dated by the sampler. COC forms will include the following information: project name, sample number, time collected, matrix, designated analyses, type of sample, preservative, and name of sampler. Pertinent notes or comments, such as positive results during sample screening, are also indicated on the COC form. An example COC form is included in Appendix V, SOP CTO 154-10.

Information similar to that contained on the COC form is provided on the sample label, which is securely attached to the sample bottle. Sample labels will include, at a minimum, the following information: sample number, date and time of collection, analysis required for the sample aliquot in the associated sample

container, and a space for the laboratory sample number. The procedures for sample numbering by TtNUS are described in Appendix V, SOP CTO 154-9.

Site conditions during sampling and the care with which samples are handled may factor into the degree to which samples represent the media from which they are collected. This, in turn, could affect the ability of decision makers to make accurate and timely decisions concerning the contamination status of the site. As appropriate, logbooks are assigned to, and maintained by, key field team personnel. The logbooks are used to record daily conditions/activities such as weather conditions, dates/times of significant events, level of PPE used, boring activities, actual sample collection locations, photographs taken, problems encountered during field activities, chemical screening results, and corrective actions taken to overcome problems. In addition, the names of site visitors and the purpose of their visits shall be recorded. Field logbook assignments shall be recorded in the Site Logbook or other central file whose location is known by the FOL and the TOM. Field logbook assignments, use, control, and archiving are governed by SOP CTO 154-10 and -11 (Appendix V). Examples of forms to be used during sampling activities are also provided in the Supplemental FSP (Appendix V) and in SOP CTO 154-10 (Appendix V). The FOL is responsible for the maintenance and security of field records at the end of each workday during field activities. At the completion of field activities, the FOL will forward field records to the TtNUS TOM. The sample records are eventually docketed into the final evidence file.

SOPs CTO 154-3, CTO 154-4, CTO 154-5, CTO 154-6 and CTO 154-11 (Appendix V) describe procedures for sample screening, packaging, and shipment. A temperature blank for use by the receiving laboratory shall be included in each cooler containing samples. Each cooler that contains samples to be analyzed for VOCs shall also include a trip blank. Each cooler shall be taped shut with strapping tape in at least two places to prevent tampering. Custody seals shall be attached as described in SOP CTO 154-11 so that the seals must be broken to open the cooler. Shipment will be made by a public courier at the next scheduled pickup following completion of sample collection.

The following procedures will be used when transferring custody of samples. As previously noted, individual custody records will accompany each sample cooler. The methods of shipment, courier name, and other pertinent information will be entered in the remarks section of the custody record. When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time on the COC form. The original record (top copy of the multi-part form) will accompany the shipment and the field sampler will retain a copy. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common courier). After COC forms have been placed within sealed shipping coolers, the signed courier air bills will serve to document COC. Upon arrival at the laboratory, internal laboratory sample custody procedures will be followed.

### **B3.B.2 Laboratory Custody Procedures**

When the selected laboratory receives a shipment of samples, the laboratory sample custodian will verify that the correct number of coolers has been received. The custodian will examine each cooler's custody seals to verify that they are intact and that the integrity of the environmental samples has been maintained. The custodian will then open each cooler and measure its internal temperature by measuring the temperature of the temperature blank. The temperature reading will be documented in the comments column of the COC form. The sample custodian will then sign the COC form and examine the contents of the cooler. Identification of broken sample containers or discrepancies between the COC form and sample labels will be recorded. The laboratory will retain the original field COC forms, providing copies of the forms with the final data package deliverable. Problems or discrepancies noted during this process will be documented on the Condition Upon Receipt Variance form in the Sample Receiving and Chain of Custody SOP (Appendix IV) and promptly reported to the TtNUS TOM. Samples will be logged into the laboratory information management system. Other pertinent issues relating to laboratory sample custody, tracking, and contacting the laboratory and client project manager are presented in the Sample Receiving and Chain of Custody (PITT-QA-0051) laboratory SOP (Appendix IV). The laboratory Sample Receiving and Chain of Custody SOP (Section 4.3 and 4.9) in Appendix D provides additional detail on the procedure to report this information to the TtNUS project manager.

If sample bottles are broken or cracked or if the laboratory can not use a sample for the analysis, the laboratory project manager will contact the TtNUS TOM to determine the appropriate corrective action. Corrective actions may include using sample from another sample bottle if enough sample is available to conduct the analysis or if TtNUS is in the field collecting samples the sample location will be resampled. If TtNUS has demobilized from the site, the data will be lost).

### **B3.B.3 Final Evidence Files**

SouthDiv and NTC Great Lakes will be the repository for documents that constitute evidence relevant to sampling and analysis activities as described in this QAPP. NTC Great Lakes will be the custodian of the evidence files and will maintain the contents of these files, including relevant records, reports, logs, field notebooks, pictures, subcontractor reports, and data reviews in a secure, limited-access location and under custody of the NTC Great Lakes Environmental Site Manager. The control file will include at a minimum:

- Field logbooks

- Field data and data deliverables
- Photographs and negatives
- Drawings
- Soil boring logs
- Laboratory data deliverables
- Data validation reports
- Data assessment reports
- Progress reports, QA reports, interim project reports, etc.
- Custody documentation (forms, air bills, etc.)

Upon completion of the contract, files associated with this investigation will be maintained at NTC Great Lakes and will be available for inspection by the regulatory agencies for at least six years. Prior to disposal of the records, the records will be offered to the IEPA.

#### **B4 ANALYTICAL METHODS REQUIREMENTS**

Chemical analyses, with the exception of grain size, will be conducted at an Illinois- and Navy-certified laboratory. Grain size analyses will be conducted at a subcontracted laboratory. The Tetra Tech Owing Mill Laboratory will be procured if sediment toxicity testing is required for the sampling event at Site 17. The address and contact information for the chemical analyses laboratory is:

Veronica Bortot  
(412) 820-8380  
STL Pittsburgh  
450 William Pitt Way  
Pittsburgh, PA 15238

The laboratory SOPs for sample preparation (i.e.; extractions, digestions, dilutions, etc.) analyses and general laboratory procedures are listed in Appendix IV. A summary of target compound/analyte fractions and the associated sample preparation and analysis SOPs, including cleanup is presented in Table B-11.

A summary of the laboratory method validation study (detection limit study) can be found in Appendix IV (Policy QA-005).



Table A-16 summarizes the quantities and types of non-calibration QC sample that will be collected and/or analyzed and the project specific acceptance limits. Descriptions of the non-calibration QC samples are included in Section B5.

## **B5 QUALITY CONTROL (QC) REQUIREMENTS**

### **B5.A Field Sampling QC**

TtNUS has established a QC program to monitor and assess the quality of field work performed during environmental investigations. That program includes various types of QC samples as indicated in Sections B2, B3, and B4 and the Supplemental FSP (Appendix V).

The field QC samples consist of field duplicates, trip blanks, equipment rinsate blanks, source water blanks, and temperature blanks. Temperature blanks will be included in each cooler submitted to the laboratory to monitor sample storage conditions prior to arrival at the laboratory. With the exception of temperature blanks, each type of field QC sample undergoes the same preservation, analysis, and reporting procedures as the related environmental samples. Target precision and accuracy values, as applicable, for field QC samples are presented in Table A-16. The field QC samples to be used for this project are described as follows:

#### **B5.A.1 Source Water Blanks**

Source water blanks sample the analyte-free water and potable water sources used for decontaminating sampling equipment. Source water blanks determine whether the analyte-free water (used for decontaminating sampling equipment) or the potable water (used for steam cleaning) may be contributing to sample contamination.

#### **B5.A.2 Field Duplicates**

Field duplicates for chemical constituents will be collected and analyzed as a measure the cumulative uncertainty (i.e., precision) of the sample collection, splitting, handling, storage, preparation, and analysis operations, as well as natural sample heterogeneity that is not eliminated through simple mixing in the field. A field duplicate is collected by mixing a volume of sample and splitting it into two separate sample containers that are labeled as individual field samples (one of which becomes the duplicate). For ground water and surface water samples, field duplicates may be generated by collecting individual water samples from the same well or water source in rapid succession rather than splitting a given volume of

water. Field duplicates are labeled as individual environmental samples and are not identified to the laboratory as duplicate samples.

#### **B5.A.3 Rinsate Blanks**

Equipment rinsate blanks or rinsate blanks are collected under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after sampling and decontamination and prior to use. These blanks would identify sample cross-contamination through improperly cleaned sampling equipment.

#### **B5.A.4 Trip Blanks**

Trip blanks are samples of deionized water that are analyzed for VOCs. These blanks would identify cross-contamination of the samples by VOCs during sample shipment.

#### **B5.A.5 Temperature Blanks**

Temperature blanks are vials of water inserted into each sample cooler prior to shipment from the field. The temperature of the temperature blank is measured upon receipt at the laboratory to assess whether samples were properly cooled during transit.

#### **B5.A.6 Replicate Measurements**

Replicate measurements are made of well stabilization parameters (pH, turbidity, specific conductance, etc.) to make sure that the groundwater collected from well is of a stable composition.

#### **B5.B Analytical QC Checks**

The selected laboratory will operate QC programs that ensure the reliability and validity of the analyses performed at the laboratory. The laboratory's QA plan describes the policies, organization, objectives, QC activities, and specific QA functions used by that laboratory. The analytical procedures are documented in SOPs. Each analytical SOP specifies minimum QC requirements. As previously noted, SOPs for the analyses to be performed during this investigation are included in Appendix IV of this QAPP. Table B-11 lists the SOPs associated with each analytical procedure. In addition, the laboratories maintain SOPs regarding general laboratory QA operations. Several of these SOPs, as applicable, are also included in Appendix IV. The Table of Contents for Appendix IV lists titles and corresponding numbers for laboratory SOPs contained in the appendix.

Internal laboratory analytical QC requirements beyond those used for instrument calibration QC are highlighted in the remainder of this section. Additional QC requirements, specific to the Naval Facilities Engineering Service Center (NFESC) QA Program, are also specified, as applicable, for each of the QC checks. Target precision and accuracy values (control limits) are presented in Tables B-12 through B-16. The applicable analytical SOPs should be consulted for calibration QC measures.

#### **B5.B.1 Laboratory Control Samples (LCS)**

LCS provide a means to monitor the overall performance of each step of the analysis, including the sample preparation. These are solid samples (soil and sediment analyses) or blank spikes (water analyses) that contain concentrations of analytes that are known with a specified degree of certainty.

Based on the requirements of the NFESC QA program, LCS for metals analyses must contain the analytes of interest, whereas LCS for multiple-analyte organic methods must contain at least two targeted analytes from each major class of compounds subject to analysis. Target analytes for LCS are listed in Tables B-17 through B-21.

Based on NFESC QA program requirements, if recovery of a LCS falls outside the control limits, the laboratory will reject the data for the analytical batch and take corrective action. The associated samples, extracts, or digestates may be reanalyzed a single time, and if the LCS recoveries meet acceptance criteria, the data will be reported. If LCS analyte recovery is still outside the acceptance limits, the associated samples in the preparation batch will be reprocessed, if sufficient sample is available and holding times have not lapsed. If re-preparation or reanalysis is not possible, the data will be flagged and the sample delivery group (SDG) narrative will include details of the failed LCS.

#### **B5.B.2 Laboratory Duplicates**

Laboratory duplicates will be analyzed for metals and miscellaneous parameters to measure the cumulative uncertainty (i.e., precision) of the sample handling, subsampling, preparation, laboratory storage, and analysis operations within the laboratory, as well as sample heterogeneity that is not eliminated through simple mixing in the laboratory. Laboratory duplicates are two subsamples obtained by the laboratory analyst after mixing the sample. If chemical analysis RPD values exceed QC limits for laboratory duplicates, the analytical process will be investigated to assess whether the observed RPD is an indication of a deficient analytical system or of excess sample heterogeneity.

### **B5.B.3 Internal Standards**

Internal standards are applied to each sample analyzed by GC/MS to make sure that the analysis sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50% to + 100%) from the associated 12-hour calibration standard.

### **B5.B.4 Laboratory Method Blanks**

Laboratory method blanks or preparation blanks are analyte-free matrices prepared and analyzed in accordance with the analytical method employed to determine whether contaminants originating from laboratory sources have been introduced and have affected environmental sample analyses. Analyte-free water is used as a blank for water analyses. A method blank for organic soil sample analyses consists of an aliquot of sand subjected to the same preparation and analysis as the environmental samples. The solid method blank results are presented on a dry-weight basis assuming 100 percent solids. Native soils devoid of acid-leachable metals do not exist. Therefore, a method blank for inorganic soil sample analysis consists of an aliquot of analyte-free water that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. The aqueous results are normalized to a fictitious soil sample and presented on a dry-weight basis assuming 100 percent solids.

Acceptance criteria for laboratory method blanks and corrective actions for non-compliant results are described in the applicable analytical SOPs included in Appendix IV. Under no circumstances would laboratory method blank contaminant values be subtracted from environmental sample analytical results.

### **B5.B.5 Matrix Spikes (MS)**

MS are environmental samples to which known quantities of analytes are added prior to sample preparation (digestion or extraction). These samples provide information about the heterogeneity of the samples as well as the effect of the sample matrix on the sample digestion and measurement methodology.

MS, to conform to NFESC requirements, will contain as many representative analytes as practicable. For many analyses, the spiking list will consist of most or all of the target analytes. For VOC and SVOC analyses, a shortened spiking list will be used (see Tables B-12 and B-13).

If the MS recovery is not within applicable control limits (as listed in Tables B-12 through B-16), the laboratory will assess the batch to determine whether the spike results are attributable to a matrix effect

or are the result of other problems in the analytical process. Based on NFESC requirements, if the batch QC elements that are not affected by the sample matrix are in control (e.g., method blank, LCS, calibration checks) and if there is no evidence that spiking was not properly performed, the poor spike recovery may be attributed to matrix effects. In this case, the associated data will be flagged, but reparation and reanalysis will not be required. If any of the batch QC elements which are not affected by the sample matrix are out of control, or if there is evidence that spiking may have been improperly performed, the MS sample will be reprocessed through the entire analytical sequence. If insufficient sample is available, or if holding times have passed, the laboratory will flag the associated data. Details of noncompliant and laboratory duplicate results will be included in the SDG narrative.

#### **B5.B.6 Matrix Spike Duplicates (MSD)**

MSD are duplicates of matrix spikes and are used for estimating the precision of organic target analyte analyses. They are used in lieu of simple duplicate samples because native environmental samples frequently do not exhibit detectable levels of organic target analytes, which prevents the calculation of RPD values. Precision criteria for MSD are presented in Tables B-12 through B-16.

#### **B5.B.7 Post Digestion Spikes (PDS)**

PDS are similar to MS except that the sample digestate, rather than the original soil sample, is spiked. These spikes are analyzed for metal target analytes only if the matrix spike recovery falls outside control limits. Comparing percent recovery (%R) between PDS and MS could help identify where in the analytical process accuracy problems are occurring. PDS will contain target analytes of interest and will be used to assist in determining whether unacceptable MS recoveries are a result of matrix effects.

#### **B5.B.8 Surrogates**

Surrogates are organic compounds (typically brominated, fluorinated, or isotopically-labeled) that are similar in nature to the compounds of concern and are not likely to be present in environmental media. They are spiked into each sample, standard, and method blank before analysis, and are used in organic chromatographic analytical procedures to check method effectiveness. Corrective actions for noncompliant surrogate recoveries are presented in the relevant SOPs included in Appendix IV of this QAPP. Details of noncompliant surrogate recoveries will be included in the SDG narrative. Accuracy criteria for surrogates are included in Tables B-12 through B-16.

#### **B5.B.9 Additional Laboratory QC Checks**

Additional internal laboratory QC checks include mass tuning for Gas Chromatograph/Mass Spectroscopy (GC/MS) analysis, second-column confirmation for GC and High Performance Liquid Chromatography (HPLC) analyses, and others. Specific QC requirements for each of these QC checks are provided in the applicable SOPs included in Appendix IV of this QAPP.

### **B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS**

#### **B6.A Field Instrument Maintenance**

Field instrument maintenance procedures are described in Section B2.C and the Supplemental FSP (Appendix V). The SOPs in the Supplemental FSP provide details on maintenance of specific field equipment as well as the manufacturers literature that is with the equipment.

#### **B6.B Laboratory Instrument Maintenance**

Proper maintenance of laboratory instruments and equipment is essential. Maintenance intervals are established for each instrument based on manufacturers' recommendations. The instruments are labeled with a model number and serial number, and a maintenance logbook is maintained for each instrument. Personnel are alert to the maintenance status of the equipment they are using at all times. Table B-22 provides a summary of preventive maintenance procedures for key analytical instruments and equipment associated with this project.

The use of manufacturer-recommended grades or better of supporting supplies and reagents is a form of preventive maintenance. For example, gases used in the Inductively Coupled Plasma (ICP) instruments are of sufficient grade to minimize fouling of the instrument. The routine use of other supporting supplies from reputable manufacturers assists in averting unnecessary periods of instrument downtime. An inventory of critical spare parts is maintained by the laboratory to minimize instrument downtime.

### **B7 INSTRUMENTATION CALIBRATION AND FREQUENCY**

Calibration procedures for metals analyses by ICP begin with the periodic establishment of the useful linear response range and routine daily calibrations. The daily calibrations consist of analyzing at least one blank and one calibration standard, an initial calibration verification, and running calibration verification standards/blanks with each batch of samples analyzed. In all cases, an independently

prepared standard (i.e., from a second source or a different lot number from the primary source) will be used as a calibration verification solution or as the MS spiking mix.

Organic chemical analyses begin with an initial calibration of the GC, HPLC, or GC/MS system with an initial calibration curve that establishes the instrument responses as functions of analyte concentration. The initial calibration curves incorporate a calibration blank and a series of calibration standards for the target analytes and applicable internal standards or surrogate compounds. Routinely, continuous calibration is performed in which the validity of the calibration curve is checked with a known chemical standard from a source independent of the initial calibration standards. The continuing calibration standard contains the target analytes of interest and applicable internal standards and surrogate compounds. The internal standards compensate for variations in analytical response that may occur in individual chromatographic analyses. The surrogate compounds provide a means to assess the efficiency of analyte extraction and analysis for each sample.

The miscellaneous parameter analyses begin with a daily calibration of a number of calibration standards at varying concentrations for each analyte. Once an acceptable calibration linearity is established, an initial calibration verification will be performed. Continuous calibration verification will be performed at a routine frequency to check the validity of the calibration curve.

Standards used to calibrate analytical instruments must be obtained from the National Institute of Standards and Technology (NIST) or through a reliable commercial supplier with a proven record for quality standards. Commercially supplied standards will be traceable to NIST reference standards, where possible, and appropriate pedigree documentation will be obtained from the supplier. In cases where documentation is not available, the laboratory will analyze the standard and compare the results to a U.S. EPA-known or previous NIST-traceable standard.

Calibrations and associated documentation are required for laboratory instruments. The documentation for calibrations performed in-house shall identify the person performing the calibration, the instrument being calibrated, the standards used for calibration and their concentration values or other pertinent calibration values, the source of the calibration standards, and the date of calibration. Certain instruments (e.g., balances) may be calibrated by a third party. In those cases, the details of calibration as described above and a certification of acceptable performance shall be obtained from the third party. The period during which the calibration is valid must be documented.

Calibration procedures, frequency requirements, acceptance criteria, and conditions that require recalibration are described for each analytical procedure in the applicable laboratory SOPs included in Appendix IV.

## **B8 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES**

Field equipment shall be inspected prior to use to make sure that necessary parts are available. Most field equipment for this project is simple, with few to no moving parts. Therefore, a visual inspection prior to use shall be sufficient to make certain that the equipment is suitable for use. This visual inspection shall occur during mobilization and during each use by the person using the equipment. For instruments that are calibrated periodically the instrument operator shall verify that the calibration is current prior to using the instrument.

Laboratory inspection and acceptance requirements are provided in the Laboratory Quality Assurance Plans. The plans present the following specifications for inspection and acceptance of supplies and consumables:

- Requirements to follow individual SOP specifications for grades of chemicals necessary to achieve acceptable analytical performance. SOPs are required to detail the necessary grade of chemicals, including compressed gases.
- Requirements to obtain primary chemical standards from reliable sources that use calibrated glassware in the preparation of the standards and to maintain certificates supplied with the standards. Emphasis is on obtaining NIST-traceable standards where possible.
- Storage of chemical standards in accordance with applicable SOPs and in a manner that preserves their integrity.
- Routine monitoring of deionized water and other solvents to make sure that analytical systems, samples, and standards are not contaminated.
- Requirements to record the date received and the date opened on each container of chemical used for analysis.



## **B9 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)**

A soil investigation was conducted in 1988 by Dames & Moore. The investigation objective was to verify the existence of chemical releases to the Site 7 environment. Soil sampling and analyses were conducted in accordance with the Detailed Field Procedures and Fieldwork QA in Appendix A of the Technical Memorandum on the RI Verification Step and were reported in Technical Memorandum on the RI Verification Step (Dames & Moore, 1991). Soil samples were acquired to a depth of 2 feet. Analyses were performed for VOCs and selected inorganics using standard U.S. EPA analytical methods. Evaluation of water was not included as part of that investigation.

The objectives and sampling strategy of the previous investigation were consistent although the analyte list of the past investigation is considered somewhat limited for the purpose of the present investigation. This is because the present investigation is expanded relative to the original investigation to include the evaluation of risk to human and ecological receptors.

Limited measurement data were available for Site 7 at the outset of this investigation. Maps, past sampling and analysis data, and general operational history were obtained from the following sources:

- Technical Memorandum on the Remedial Investigation Verification Step for the Naval Training Center Great Lakes, NEESA 21-011, Volume 2A, Main Report and Appendices A-F, Naval Energy and Environmental Support Activity, Port Hueneme, California 93043, November 1991. (Dames & Moore, 1991).
- Technical Memorandum for Support of the Relative Risk Evaluation at Various Activities, March 1996. (Brown & Root Environmental, 1996).

In addition to the above sources, photographs were taken of Site 7 in September 2000 by TtNUS. The photographs are kept in the project file for the Navy at TtNUS Pittsburgh office. They will become part of the final administrative record upon completion of this project.

The data quality for the past soil sampling at Site 7 is unknown. The data could not be validated because the laboratory went out of business before the end of the project and data needed for validation were unavailable. Therefore, none of the data described above will be used in making decisions concerning risk or the nature and extent of contamination for the present investigation. Although the past analytical data will not be used for making project decisions, the data were used in the present investigation to:

- identify sampling locations
- establish sampling boundaries
- focus the list of contaminants to those that could reasonably be associated with the site

The locations of buildings, electrical transformers, the underground concrete vault, former above ground storage tanks, sewer drains, drainage ditches, habitats and vegetation identified on maps used for the previous investigation were verified through photographs and first hand by visual observation. Key investigative elements such as sampling locations will be surveyed as part of the present investigation to make sure that their locations are accurate to within industry standards.

## **B10 DATA MANAGEMENT**

### **B10.A Data Recording**

A detailed data management plan is provided in Appendix VI. The plan describes the aspects of data management from project planning through entry of historical data into the pertinent databases, and receipt and processing of laboratory data.

### **B10.B Data Validation**

Validation techniques for field measurements and laboratory analytical data are presented in this section.

#### **B10.B.1 Procedures Used to Validate Field Data**

Field measurements will not be subjected to a formal data validation process. Validation of field data will be limited to real-time inspection by the FOL of observations relative to actual site conditions and activities. In addition, field technicians will make sure that the equipment used for sample collection is performing adequately via compliance with the applicable SOPs.

#### **B10.B.2 Procedures Used to Validate Laboratory Data**

Ten percent of the laboratory analytical data will be subjected to data validation to make certain that the data are of evidentiary quality. Validation of analytical data will be performed by the TtNUS Environmental Chemistry/Toxicology Department at the TtNUS Pittsburgh office. Final review and approval of validation deliverables will be completed by the department's Data Validation Manager.

The laboratory will submit data validation packages with the required information as presented in Table A-17 of Section A9.B.2. Prior to statistical analyses, analytical results will be validated against the applicable analytical methods, the SOPs included in Appendix IV, and the requirements of this QAPP. Validation of these data will conform to the U.S. EPA Region 5 Standard Operating Procedures for Validation of CLP Inorganic and Organic Data (U.S. EPA, 1993a) and the National Functional Guidelines for Inorganic and Organic Data Review (U.S. EPA, 1994b and 1994c) to the greatest extent practicable. Validation SOPs are included in Appendix IV. Data validators will review the chemical analytical data packages submitted by the laboratory. The data validators will check that the data were obtained using approved methodology, that the appropriate level of QC and reporting was conducted, and that the results are in conformance with QC criteria.

On the basis of the data validation results, the data validator will generate a report describing detected data limitations. The report will be reviewed internally by the Data Validation Manager prior to submittal to the TOM. Data review will be extended beyond this routine validation by involving the project chemist, statistician, and risk assessor, as appropriate, to examine the data for anomalies. This additional review may result in more detailed inspections of the data to determine the cause of, and to rectify, individual anomalies. The impact of data qualifiers on data usability will also be assessed. The following data validation qualifiers will be used as appropriate when conducting data validation:

- U - Value is a nondetected result as reported by the laboratory, or is considered nondetected as a result of blank contamination and should not be considered present.
- J - Positive result is qualified as estimated, "J", due to technical noncompliances.
- UJ - Nondetected result is qualified as estimated, "UJ", due to technical noncompliances.
- R - Positive result is qualified as rejected, "R", due to technical noncompliances.
- UR - Nondetected result is qualified as rejected, "UR", due to technical noncompliances.

#### **B10.C Data Transformation/Data Reduction**

Equations used to reduce data in the laboratory and field are provided in the applicable SOPs. Field and laboratory SOPs are attached to this QAPP in Appendices V and IV, respectively. Data review requirements in the field is the responsibility of the person generating the data and the FOL. Those persons review the data to make sure that the reported results are consistent with site conditions.

Calibration data must be reviewed to make sure that calibrations are accurate to within the expectations of the instrument user and project specific requirements, as applicable. For example, check standards shall yield the intended result within the tolerance established by the check standard manufacturer.

Data reduced at TtNUS after receipt from the field can be processed in numerous ways, depending on the intended data use. Details of the software and processes used for database and geographical information system processing are provided in the Data Management Plan, Appendix VI. In addition, statistical and other mathematical analyses may be performed using Statistica (Mathsoft) or Excel (Microsoft). With some exceptions, major types of calculations shall be checked by at least one manual calculation or by an independent reviewer and documented in the final project report. Exceptions to this requirement are geostatistical and modeling calculations that would require an inordinate amount of time to validate manually. Geostatistical computations are validated using an independent software package. A qualified geologist or hydrogeologist reviews the outputs of modeling software for reasonableness and consistency with project data. If data are entered into the database manually, a system of double data entry is used to verify that the data are accurate.

#### **B10.D     Data Transmittal/Transfer**

Details of data transfer from laboratory to TtNUS are provided in Appendix VI. Other data transfers are usually via a particular organization's intranet or the Internet, depending on the origin and destination of the data. For example, data transfers between TtNUS and Navy are typically effected via electronic mail with and without attachments. Data transfer software may vary because of the entities involved, but data transfer methods have stood the test of time through repeated use among the project partners. Formal written documents are checked for grammatic, typographic, syntactic, and technical accuracy through a variety of manual reviews and use of electronic spell checking software that is part of the word processing software.

#### **B10.E     Data Analysis**

Data analysis occurs primarily at the laboratory and at TtNUS using computer systems typical of the environmental industry. No proprietary in house software is used. The statistical and other mathematical data analyses are conducted using Statistica (Mathsoft) or Excel (Microsoft). However, project-specific requirements may occasionally dictate the use of other software. Such situations are handled on a case-by-case basis under the direction of the TOM. Third party software is assumed to function to industry standards and is not validated independently. Individual calculations or visual descriptions are checked

for consistency with expectations and site conditions. When feasible, the calculations are checked manually, as described in Section B10.C.

#### **B10.F     Data Assessment**

The software used for visualizing data and conducting geostatistical analyses is Environmental Visualization Systems (EVS) (C Tech Development Corporation). EVS geostatistical variogram generation is cross-validated through the use of GeoPack (U.S. EPA). Third party software is assumed to function to industry standards and is not validated independently. Individual calculations or visualizations are checked for consistency with expectations and are checked manually, when feasible, as described in Section B10.

Contaminant migration modeling is typically done using MODFLOW, RT3D, MT3D, or similar software. These software packages are combined under a modeling package shell called Groundwater Modeling System (GMS) (U.S. EPA, USAFCEE, et al.). The project geologist or hydrogeologist selects the appropriate software depending on site conditions. A qualified geologist or hydrogeologist reviews the outputs for reasonableness and consistency of modeling software with project data and site conditions.

Detailed descriptions of the methodology used to evaluate human health and ecological risk are presented in Appendices I and II. The methodologies identify the receptors, exposure pathways, assumed exposure parameters, and the specific equations used for evaluating risk.

#### **B10.G     Data Tracking**

TtNUS detailed data receipt and tracking requirements are handled in accordance with the Data Management Plan, Appendix VI. Laboratory data generation and tracking is managed in accordance with laboratory-specific SOPs and the laboratory QA plan using a Laboratory Information Management System (LIMS). Copies of the SOPs are included in Appendix IV.

#### **B10.H     Data Storage and Retrieval**

Data storage and retrieval is achieved in accordance with the detailed Data Management Plan provided in Appendix VI. Major project documents become part of the central project files. The TOM is responsible for compiling those records and making sure that they are maintained in the central project file at TtNUS. The TOM will also be responsible for making sure that the files are transferred to SouthDiv and NTC Great Lakes for archiving after completion of the project.

## **B10.I     Data Security**

Data are maintained in a secure environment at TtNUS. Security is ensured by limiting access to records and related data to authorized personnel with authorized personnel card reader badges. The simplicity of the data security environment obviates the need for data security SOPs. Computers, phone voice mail, and access to the TtNUS intranet are password-protected. A corporate computer use policy governs the issuance, security, and use of computer passwords, software, and hardware. Laboratory data security is ensured in a similar manner, as described more fully in the laboratory QAPP, which is included in Appendix IV.

TABLE B-1

**SURFACE SOIL/SUBSURFACE SOIL SAMPLES  
SITE 7 – RTC SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2**

Sample/ Boring No.	Sample Depth	General Location	Analyses					
			TCL VOCs	TCL SVOCs	TAL Metals	TOC	TCLP Organics & Inorganics	Grain Size
SURFACE/SUBSURFACE SOIL								
07SS01/ 07SB01	0–1 feet TBD <sup>(2)</sup>	Northwest of the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS02/ 07SB02	0–1 feet TBD <sup>(2)</sup>	In the L-shape stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS03/ 07SB03	0–1 feet TBD <sup>(2)</sup>	In the L-shape stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS04/ 07SB04	0–1 feet TBD <sup>(2)</sup>	North of the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS05/ 07SB05	0–1 feet TBD <sup>(2)</sup>	East of the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS06/ 07SB06	0–1 feet TBD <sup>(2)</sup>	East of the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS07/ 07SB07	0–1 feet TBD <sup>(2)</sup>	East of the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS08/ 07SB08	0–1 feet TBD <sup>(2)</sup>	West of the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS09/ 07SB09	0–1 feet TBD <sup>(2)</sup>	West of the Former Drum Accumulation Area	X	X	X	X	X	X <sup>(1)</sup>
07SS10/ 07SB10	0–1 feet TBD <sup>(2)</sup>	North of Building 1212 Outlet Pipe	X	X	X	X	X	X <sup>(1)</sup>

TABLE B-1

**SURFACE SOIL/SUBSURFACE SOIL SAMPLES  
SITE 7 – RTC SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 2**

Sample/ Boring No.	Sample Depth	General Location	Analyses					
			TCL VOCs	TCL SVOCs	TAL Metals	TOC	TCLP Organics & Inorganics	Grain Size
07SS11/ 07SB11	0–1 feet TBD <sup>(2)</sup>	North of Building 1212	X	X	X	X	X	X <sup>(1)</sup>
07SS12/ 07SB12	0–1 feet TBD <sup>(2)</sup>	South of Former Drum Accumulation Area	X	X	X	X	X	X <sup>(1)</sup>
07SS13/ 07SB13	0–1 feet TBD <sup>(2)</sup>	West of Former Drum Accumulation Area	X	X	X	X	X	X <sup>(1)</sup>
07SS14/ 07SB14	0–1 feet TBD <sup>(2)</sup>	In the L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS15/ 07SB15	0–1 feet TBD <sup>(2)</sup>	Southeast of Former Drum Accumulation Area	X	X	X	X	X	X <sup>(1)</sup>
07SS16/ 07SB16	0–1 feet TBD <sup>(2)</sup>	South of L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>
07SS17/ 07SB17	0–1 feet TBD <sup>(2)</sup>	North of L-shaped stained area	X	X	X	X	X	X <sup>(1)</sup>

1 To be collected from 3-4 arbitrary soil samples.

2 VOC sample to be collected from 6"-1 foot in the surface soil and at a discrete one-foot interval from 1 to top of groundwater based on the following: elevated PID readings; visual observations of contamination/non-native soils; immediately above the water table (if encountered prior to 10 feet). SVOC and inorganic samples to be collected from 0 to 1 foot in the surface soil and a composite of the soil boring for the subsurface soil. See Section B2 for details.

TBD = To be determined

TOC = Total organic carbon

TCLP = Toxicity Characteristic Leaching Procedure

PID = Photoionization detector

SVOCs = Semivolatile organic compounds

VOCs = Volatile organic compounds



**TABLE B-2**  
**FIELD SAMPLE SUMMARY - SOIL**  
**SITE 7 - RTC SILK SCREENING SHOP**  
**NTC GREAT LAKES, ILLINOIS**

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total <sup>(1)</sup>
<b>Surface/Subsurface Soil</b>								
TCL VOCs, ethyl alcohol and ethyl acetate	SW-846 Methods 5035 / 8260B	34	3	1	TBD	TBD	1	39
TCL SVOCs	SW-846 Method 8270C	34	3	1	NA	TBD	1	39
TAL Metals	SW-846 Method 6010B / 7471A	34	3	1	NA	TBD	1	39
TCLP Organics	SW-846 Method 1311/8260B/8270C/8081A/8151A	34	3	1	TBD	NA	1	39
TCLP Inorganics	SW-846 1311/6010B/7000A series	34	3	1	NA	NA	1	39
Total Organic Carbon	Walkley Black	34	3	NA	NA	NA	NA	37
Grain Size	ASTM D422	4	NA	NA	NA	NA	NA	4

1- Totals do not include the number of Trip Blanks or Ambient Blanks.

TCL = Target Compound List

VOCs = Volatile organic compounds

SVOCs = Semivolatile organic compounds

TAL = Target Analyte List

TCLP = Toxicity Characteristic Leaching Procedure

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

NA = Non Applicable

**TABLE B-3**

**WELL SUMMARY  
SITE 7 - RTC SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

WELL NAME	WELL LOCATION	ESTIMATED DEPTH (bgs)	ESTIMATED SCREENED INTERVAL (bgs)
NTC07MW01	West of L-shaped stained area	20 ft.	10 to 20 ft.
NTC07MW02	In the L-shaped stained area	20 ft.	10 to 20 ft.
NTC07MW03	In the L-shaped stained area	20 ft.	10 to 20 ft.
NTC07MW04	North of the L-shaped stained area	20 ft.	10 to 20 ft.
NTC07MW05	East of the L-shaped stained area	20 ft.	10 to 20 ft.
NTC07MW06	East of the L-shaped stained area	20 ft.	10 to 20 ft.
NTC07MW07	East of the L-shaped stained area	20 ft.	10 to 20 ft.

bgs = below ground surface

**TABLE B-4**  
**GROUND WATER SAMPLES**  
**SITE 7 – RTC SILK SCREENING SHOP**  
**NTC GREAT LAKES, ILLINOIS**

Well/ Sample Number	General Location	ANALYSES				
		TCL VOCs	TCL SVOCs	TAL Metals	TOC	Field Parameters
GROUND WATER						
07MW01 <sup>(1)</sup>	West of L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>
07MW02 <sup>(1)</sup>	In the L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>
07MW03 <sup>(1)</sup>	In the L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>
07MW04 <sup>(1)</sup>	North of the L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>
07MW05 <sup>(1)</sup>	East of the L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>
07MW06 <sup>(1)</sup>	East of the L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>
07MW07 <sup>(1)</sup>	East of the L-shaped stained area	X	X	X <sup>(2)</sup>	X	X <sup>(3)</sup>

1. New temporary monitoring well
2. Filtered ground water samples will be collected only if a reading of less than 10 NTUs is not achieved during stabilization.
3. Field parameters are pH, turbidity, specific conductance, dissolved oxygen, temperature, and oxidation-reduction potential (ORP)

TCL = Target Compound List  
 VOCs = Volatile organic compounds  
 SVOCs = Semivolatile organic compounds  
 TAL = Target Analyte List  
 TOC = Total Organic Carbon

TABLE B-5

**FIELD SAMPLE SUMMARY - GROUND WATER  
SITE 7 - RTC SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total <sup>(1)</sup>
<b>Ground Water</b>								
TCL VOCs to include ethyl alcohol and ethyl acetate	SW-846 Method 8260B	7	1	1	TBD	TBD	1	10
TCL SVOCs	SW-846 Method 8270C	7	1	1	NA	TBD	1	10
TAL Metals	SW-846 Method 6010B/7471A	7	1	1	NA	TBD	1	10
Field Parameters	Field Meter <sup>(2)</sup>	7	NA	NA	NA	NA	NA	7

1 Totals do not include the number of Trip Blanks or Ambient Blanks.

2 Field parameters include temperature, pH, specific conductance, turbidity, ORP and dissolved oxygen.

TCL = Target Compound List

VOCs = Volatile organic compounds

SVOCs = Semivolatile organic compounds

TAL = Target Analyte List

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

ORP = Oxidation reduction potential

NA = Not applicable.

**TABLE B-6**  
**SURFACE WATER SAMPLES**  
**SITE 17 – PETTIBONE CREEK/BOAT BASIN**  
**NTC GREAT LAKES, ILLINOIS**

Well/ Sample Number	General Location	Analyses				
		TCL VOCs	TCL SVOCs	TAL Metals	Dissolved TAL Metals <sup>(1)</sup>	TCL Pest/PCBs
SURFACE WATER						
17SW01	Pettibone Creek	X	X	X	X	X
17SW02	Pettibone Creek	X	X	X	X	X
17SW03	South Branch of Pettibone Creek	X	X	X	X	X
17SW04	South Branch of Pettibone Creek	X	X	X	X	X
17SW05	Boat Basin	X	X	X	X	X
17SW06	Boat Basin	X	X	X	X	X

1 Filtered and unfiltered surface water samples will be collected at all locations

TCL = Target Compound List

VOCs = Volatile organic compounds

SVOCs = Semivolatile organic compounds

TAL = Target Analyte List

Pest = Pesticides

PCBs = Polychlorinated biphenyls

TABLE B-7

**FIELD SAMPLE SUMMARY - SURFACE WATER  
SITE 17 - PETTIBONE CREEK/BOAT BASIN  
NTC GREAT LAKES, ILLINOIS**

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total <sup>(2)</sup>
<b>SURFACE WATER<sup>(1)</sup></b>								
TCL VOCs to include ethyl alcohol and ethyl acetate	SW-846 Method 8260B	6	1	1	TBD	TBD	1	9
TCL SVOCs	SW-846 Method 8270C	6	1	1	TBD	TBD	1	9
TAL Metals	SW-846 Method 6010B / 7470A	6	1	1	NA	TBD	1	9
Dissolved TAL Metals	SW-846 Method 6010B / 7470A	6	1	1	NA	TBD	1	9
TCL Pesticides	SW-846 Method 8081A	6	1	1	NA	TBD	1	9
TCL PCBs	SW-846 Method 8082	6	1	1	NA	TBD	1	9

1 Field parameters include temperature, pH, specific conductance, turbidity, ORP, and dissolved oxygen.

2 Totals do not include the number of Trip Blanks or Ambient Blanks.

TCL = Target Compound List

VOCs = Volatile organic compounds

SVOCs = Semivolatile organic compounds

TAL = Target Analyte List

PCBs = Polychlorinated biphenyls

ORP = Oxidation reduction potential

NA = Not Applicable

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

TABLE B-8

**SEDIMENT SAMPLES**  
**SITE 17 – PETTIBONE CREEK/BOAT BASIN**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 1 OF 5**

Sample/ Boring No.	Sample Depth	General Location	Analyses						
			TAL Metals	TCL PEST / PCB'S	PAHs	TOC	AVS / SEM²	Grain Size	pH
SEDIMENT SAMPLE									
17SD01	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD02	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD03	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD04	0-4 cm / at 1 ft.	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD05	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD06	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD07	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD08	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD09	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD10	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD11	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD12	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD13	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD14	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD15	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD16	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X

TABLE B-8

**SEDIMENT SAMPLES  
SITE 17 – PETTIBONE CREEK/BOAT BASIN  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 5**

Sample/ Boring No.	Sample Depth	General Location	Analyses						
			TAL Metals	TCL PEST / PCB'S	PAHs	TOC	AVS / SEM <sup>2</sup>	Grain Size	pH
17SD17	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD18	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD19	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD20	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD21	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD22	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD23	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD24	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD25	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD26	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD27	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD28	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD29	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD30	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD31	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD32	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD33	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD34	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X



TABLE B-8

**SEDIMENT SAMPLES**  
**SITE 17 – PETTIBONE CREEK/BOAT BASIN**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 3 OF 5**

Sample/ Boring No.	Sample Depth	General Location	Analyses						
			TAL Metals	TCL PEST / PCB'S	PAHs	TOC	AVS / SEM <sup>2</sup>	Grain Size	pH
17SD35	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD36	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD37	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD38	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD39	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD40	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD41	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD42	0-4 cm / at 1 ft	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD43	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD44	0-4 cm	Pettibone Creek	X	X	X	X	X	X <sup>(1)</sup>	X
17SD45	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD46	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD47	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X

TABLE B-8

**SEDIMENT SAMPLES**  
**SITE 17 – PETTIBONE CREEK/BOAT BASIN**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 4 OF 5**

Sample/ Boring No.	Sample Depth	General Location	Analyses						
			TAL Metals	TCL PEST / PCB'S	PAHs	TOC	AVS / SEM <sup>2</sup>	Grain Size	pH
17SD48	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD49	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD50	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD51	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD52	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD53	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X

TABLE B-8

**SEDIMENT SAMPLES**  
**SITE 17 – PETTIBONE CREEK/BOAT BASIN**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 5 OF 5**

Sample/ Boring No.	Sample Depth	General Location	Analyses						
			TAL Metals	TCL PEST / PCB'S	PAHs	TOC	AVS / SEM <sup>2</sup>	Grain Size	pH
17SD54	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD55	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X
17SD56	0-4 cm 4 cm – 3' 3' – 6' 6' – 10'	Boat Basin	X	X	X	X	X	X <sup>(1)</sup>	X

1. To be collected for field analysis and approximately 6 samples will be submitted for laboratory analysis
2. 3 samples to be collected from 3 different grain sizes (total of 9 samples), based on field observations.

Note: 10% of the samples will be analyzed for TCL VOCs and SVOCs. The samples will be randomly selected in the field.  
 SVOCs = Semivolatile organic compounds  
 VOCs = Volatile organic compounds  
 TAL = Target Analyte List  
 TOC = Total organic carbon  
 TCLP = Toxicity Characteristic Leaching Procedure  
 AVS = Acid Volatile Sulfides  
 SEM = Simultaneously Extracted Metals

TABLE B-9

**FIELD SAMPLE SUMMARY - SEDIMENT  
SITE 17 - PETTIBONE CREEK/BOAT BASIN  
NTC GREAT LAKES, ILLINOIS**

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total <sup>(1)</sup>
<b>Sediment</b>								
TCL VOCs <sup>(2)</sup>	SW-846 Method 5035/8260B	12	1	1	TBD	TBD	1	12
TCL SVOCs <sup>(2)</sup>	SW-846 Method 8270C and 8310	12	1	1	TBD	TBD	1	12
TCL PAHs	SW-846 Method 8310	118	12	1	TBD	TBD	6	137
TCL Pesticides	SW-846 Method 8081A	118	12	1	NA	TBD	6	137
TCL PCBs	SW-846 Method 8082	118	12	1	NA	TBD	6	137
TAL Metals	SW-846 Method 6010B / 7471A	118	12	1	NA	TBD	6	137
TOC	Walkley Black	118	12	1	NA	TBD	6	137
AVS / SEM <sup>(3)</sup>	EPA Draft Method	9	1	1	NA	TBD	1	12
pH	SW-846 Method 9045C	118	NA	NA	NA	TBD	NA	118
Grain Size <sup>(4)</sup>	ASTM D422	6	NA	NA	NA	NA	NA	6

1. Totals do not include the number of Trip Blanks or Ambient Blanks

2 10% of the samples will be analyzed for VOCs and SVOCs

3 Selected for 9 random locations. (3 from North Branch, 3 from South Branch, and 3 from Boat Basin)

4 To be collected for field analysis and approximately 6 samples will be submitted for laboratory analysis

TCL = Target Compound List

VOCs = Volatile organic compounds

SVOCs = Semivolatile organic compounds

PAHs = Polynuclear Hydrocarbons

PCBs = Polychlorinated biphenyls

TAL = Target Analyte List

TOC = Total Organic Carbon

AVS = Acid Volatile Sulfide

SEM = Simultaneously Extracted Metals

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

NA - Not applicable

TABLE B-10

**SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 1 OF 3**

Analytical Method	Parameter	Container Material	Container Volume <sup>(1)</sup>	Preservation <sup>(2)</sup>	Holding Time <sup>(3)</sup>
<b>AQUEOUS SAMPLES</b>					
SW-846 8260B	TCL VOCs, ethyl alcohol and ethyl acetate	NA	2 X 40 ml vials	0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> if residual chlorine present, pH < 2, cool to 4°C	14 days to analysis
SW-846 8270c	TCL SVOCs	Amber glass	1 L	0.008% Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> if residual chlorine present, cool to 4°C	7 days to extraction, 40 days from extraction to analysis
SW-846 6010B/7470A	TAL Metals	HPDE or glass	400 ml	HNO <sub>3</sub> to < pH 2	180 days to analysis except mercury which is 28 days to analysis
SW-846 9012A	Cyanide	HPDE or glass	1 L	Cool to 4°C	14 days to analysis
SW-846 9060	TOC	HPDE	60 ml	H <sub>2</sub> SO <sub>4</sub> to pH < 2, cool to 4°C	28 days to analysis
<b>SOIL SAMPLES</b>					
SW-846 5035 / 8260B	TCL VOCs, ethyl alcohol and ethyl acetate	Clear wide mouth jar	4 oz.	Cool to 4°C	48 hours to extraction/preparation, 14 days from extraction to analysis
SW-846 8270C	TCL SVOCs	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction, 40 days from extraction to analysis
SW-846 6010B/7471A	TAL Metals	Clear wide mouth jar	4 oz.	Cool to 4° C	180 days to analysis except mercury which is 28 days to analysis
SW-846 9012A	Cyanide	Clear wide mouth jar	4 oz.	Cool to 4° C	14 days to analysis
Walkley Black	TOC	Clear wide mouth jar	4 oz.	Cool to 4° C	28 days to analysis
SW-846 1311/8260B/8270C/8081A/8151A	TCLP Organics	Clear wide mouth jar	16 oz.	Cool to 4° C	14 days to leach preparation: 14 days to VOC analysis; 7 days to SVOC analysis, pesticides and herbicides

**TABLE B-10**  
**SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINIOS**  
**PAGE 2 OF 3**

Analytical Method	Parameter	Container Material	Container Volume <sup>(1)</sup>	Preservation <sup>(2)</sup>	Holding Time <sup>(3)</sup>
SW-846 1311/6010B/7000A series	TCLP Inorganics	Clear wide mouth jar	16 oz.	Cool to 4° C	180 days to TCLP extraction except mercury which is 28 days to extraction; 180 days from extraction to analysis except mercury which is 28 days from extraction to analysis
ASTM D422	Grain Size	Burlap or Tyvek bag	5 to 10 lbs.	NA	Not Specified

**SEDIMENT SAMPLES**

SW-846 5035 / 8260B	TCL VOCs, ethyl alcohol and ethyl acetate	Clear wide mouth jar	4 oz.	Cool to 4°C	48 hours to extraction/preparation, 14 days from extraction to analysis
SW-846 8270C	TCL SVOCs or PAHs	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction, 40 days from extraction to analysis
SW-846 8081A	TCL Pesticides	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction, 40 days from extraction to analysis
SW-846 8082	TCL PCBs	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to extraction, 40 days from extraction to analysis
SW-846 6010B/7471A	TAL Metals	Clear wide mouth jar	4 oz.	Cool to 4° C	180 days to analysis except mercury which is 28 days to analysis
Walkley Black	TOC	Clear wide mouth jar	4 oz.	Cool to 4° C	28 days to analysis
SW-846 1311/8260B/8270C/8081A/8151A	TCLP Organics	Clear wide mouth jar	16 oz.	Cool to 4° C	14 days to leach preparation: 14 days to VOC analysis; 7 days to SVOC analysis, pesticides and herbicides
SW-846 1311/6010B/7000A series	TCLP Inorganics	Clear wide mouth jar	16 oz.	Cool to 4° C	180 days to TCLP extraction except mercury which is 28 days to extraction; 180 days from extraction to analysis except mercury which is 28 days from extraction to analysis
EPA Draft Method	AVS/SEM	Clear wide mouth jar	8 oz.	Cool to 4° C	14 days to analysis
SW-846 9045C	pH	Clear wide mouth jar	4 oz.	Cool to 4° C	Analyze immediately
ASTM D422	Grain Size	Burlap or Tyvek bag	5 to 10 lbs.	NA	Not Specified

TABLE B-10

SAMPLE CONTAINERS, PRESERVATION METHODS, AND HOLDING TIMES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINIOS  
PAGE 3 OF 3

1	Container volume may vary based on laboratory.				
2	HNO <sub>3</sub> - Nitric acid; H <sub>2</sub> SO <sub>4</sub> - Sulfuric Acid, Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> – Sodium Thiosulfate				
3	Measured from time of sample collection.				
HPDE	High Density Polyethylene Bottle	PAH	Polyaromatic Hydrocarbons	TAL	Target Analyte List
TCL	Target Compound List	TOC	Total Organic Carbon	TCLP	Toxicity Characteristic Leaching Procedure
VOCs	Volatile organic compounds	SVOCs	Semivolatiles	AVS/SEM	Acid Volatile Sulfides/Simultaneously Extracted Metals
EPA	U.S. Environmental Protection Agency	SOP	Standard Operating Procedures		
ASTM	American Society of Testing Materials				

TABLE B-11

SUMMARY OF ORGANIC, INORGANIC, AND MISCELLANEOUS ANALYTICAL PROCEDURES  
SOLID AND AQUEOUS SAMPLES  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2

Analytical Parameter <sup>(1)</sup>	Preparation Method	Analytical Method	Preparation/Analytical SOP(s) <sup>(2)</sup>
TAL Metals	<u>Aqueous</u> SW-846 Method 3010A  <u>Solid</u> SW-846 Method 3050B	SW-846 Method 6010B Trace	CORP-MT-0001
Mercury	<u>Aqueous</u> SW-846 Method 7470A  <u>Solid</u> SW-846 Method 7471A	<u>Aqueous</u> SW-846 Method 7470A  <u>Solid</u> SW-846 Method 7471A	<u>Aqueous</u> LM-H6-7470A  <u>Solid</u> CORP-MT-0007
Cyanide	SW-846 Method 9012A	SW-846 Method 9012A	PITT-WC-0018
TCL Volatile Organic Compounds	<u>Aqueous</u> SW-846 Method 5030B (25 ml purge)  <u>Solid</u> SW-846 Method 5035B (5 g purge)	SW-846 Method 8260B (25 ml purge or 5 gram sample)	CORP-MS-0002-PT
TCL Semivolatile Organic Compounds	<u>Aqueous</u> SW-846 Method 3510C/3520C  <u>Solid</u> SW-846 Method 3550B	SW-846 Method 8270C	CORP-MS-0001-PT
Appendix IX Organochlorine Pesticides	<u>Aqueous</u> SW-846 Method 3510C/3520C  <u>Solid</u> SW-846 Method 3550B	SW-846 Method 8081A	CORP-GC-0001PT
Appendix IX PCBs	<u>Aqueous</u> SW-846 Method 3510C/3520C  <u>Solid</u> SW-846 Method 3550B	SW-846 Method 8082	CORP-GC-0001PT



**TABLE B-11**

**SUMMARY OF ORGANIC, INORGANIC, AND MISCELLANEOUS ANALYTICAL PROCEDURES  
SOLID AND AQUEOUS SAMPLES  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 2**

<b>Analytical Parameter<sup>(1)</sup></b>	<b>Preparation Method</b>	<b>Analytical Method</b>	<b>Preparation/Analytical SOP(s)<sup>(2)</sup></b>
Total Organic Carbon	<u>Aqueous</u> SW-846 9060	<u>Aqueous</u> SW-846 9060	<u>Aqueous</u> NC-WC-0017
	<u>Solid</u> Walkley Black	<u>Solid</u> Walkley Black	<u>Solid</u> PITT-WC-0058
TCLP Analysis	TCLP	TCLP	CORP-IP-0004
AVS/SEM	EPA Draft Method	EPA Draft Method	AVS/SEM
Grain Size	ASTM D422	ASTM D422	S3A
pH (Soil/sediment only)	SW-846 9045C	SW-846 9045C	PITT-WC-0026

1. Refer to Table A-15 of Section A for lists of analytes where analyte groups are identified in this table.
2. Laboratory SOPs are included in Appendix IV of this QAPP.

TAL Target Analyte List  
TCL Target Compound List  
TCLP Toxicity Characteristic Leaching Procedure  
ASTM American Society of Testing Materials

EPA U.S. Environmental Protection Agency  
PCBs Polychlorinated biphenyls  
SOP Standard Operating Procedure

TABLE B-12

QUALITY CONTROL LIMITS <sup>(1)</sup>  
VOLATILE COMPOUNDS  
MATRIX SPIKE / MATRIX SPIKE DUPLICATES AND SURROGATE SPIKES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS

Compound	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
1,1,2-Trichloro-1,2,2-trifluoroethane	10-125	25	10-125	25
1,1,1-Trichloroethane	53-142	24	69-130	24
1,1,2,2-Tetrachloroethane	10-130	20	66-136	20
1,1,2-Trichloroethane	62-130	23	70-130	23
1,1-Dichloroethane	67-129	47	80-113	22
1,1-Dichloroethene	43-147	27	57-138	20
1,2,4-Trichlorobenzene	SV	SV	SV	SV
1,2-Dibromo-3-Chloropropane	70-130	20	70-130	20
1,2-Dibromoethane	70-130	20	70-130	20
1,2-Dichlorobenzene	SV	SV	SV	SV
1,2-Dichloroethane	44-145	41	67-132	20
1,2-Dichloropropane	47-144	20	68-130	20
1,3-Dichlorobenzene	SV	SV	SV	SV
1,4-Dichlorobenzene	SV	SV	SV	SV
2-Butanone (methyl ethyl ketone)	10-187	47	10-151	34
2-Hexanone	46-134	31	60-130	24
4-Methyl-2-pentanone	48-149	39	62-129	34
Acetone	40-145	37	60-134	32
Benzene	55-138	20	73-123	20
Bromodichloromethane	58-137	20	66-132	20
Bromoform	43-130	20	70-145	20
Bromomethane	10-130	23	26-186	23
Carbon disulfide	36-130	36	80-116	20
Carbon tetrachloride	39-149	55	61-143	20
Chlorobenzene	49-139	22	70-122	20
Chloroethane	10-130	24	56-151	24
Chloroform	52-140	20	65-131	20
Chloromethane	31-138	25	47-145	25
cis-1,2-Dichloroethene	70-130	20	70-130	20
cis-1,3-Dichloropropene	60-134	40	80-110	20
Cyclohexane	10-125	25	10-125	25
Dibromochloromethane	65-130	20	70-135	20
Dichlorodifluoromethane	59-150	20	59-150	20
Ethyl acetate	NA	NA	NA	NA
Ethyl alcohol	NA	NA	NA	NA
Ethylbenzene	42-131	25	70-130	25
Isopropylbenzene	40-130	20	40-130	20
Methyl acetate	10-125	25	10-125	25
Methylcyclohexane	10-125	25	10-125	25
Methylene chloride	33-170	20	59-144	20
Methyl tert-Butyl Ether	10-125	25	10-125	25
Styrene	37-132	22	70-130	22
Tetrachloroethene	39-154	22	70-130	20
Toluene	46-147	24	67-129	20
trans-1,2-Dichloroethene	70-130	20	70-130	20
trans-1,3-Dichloropropene	49-132	31	80-114	32
Trichloroethene	46-143	23	58-141	20
Trichlorofluoromethane	75-125	20	75-125	20
Vinyl chloride	29-150	43	51-133	20
Xylenes, total	37-162	20	37-162	20

(1) Quality control limits provided by STL Pittsburgh Laboratory  
%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable  
SV Included in the Semi-Volatile list

TABLE B-13

QUALITY CONTROL LIMITS <sup>(1)</sup>  
SEMIVOLATILE COMPOUNDS  
MATRIX SPIKE / MATRIX SPIKE DUPLICATES AND SURROGATE SPIKES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 1 OF 2

Compound	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
1,1'-Biphenyl	10-125	25	10-125	25
2,4,5-Trichlorophenol	29-125	29	24-143	22
2,4,6-Trichlorophenol	21-126	60	36-135	27
2,4-Dichlorophenol	42-115	44	42-115	44
2,4-Dimethylphenol	32-119	20	32-119	20
2,4-Dinitrophenol	1-191	53	1-191	53
2,4-Dinitrotoluene	10-171	45	31-131	32
2,6-Dinitrotoluene	50-158	20	50-158	20
2-Chloronaphthalene	60-118	20	60-118	20
2-Chlorophenol	17-116	54	19-124	43
2-Methylnaphthalene	40-110	50	40-110	50
2-Methylphenol (o-cresol)	33-113	39	29-115	31
2,2'-Oxybis	36-166	27	36-166	27
2-Nitroaniline	11-138	63	11-138	63
2-Nitrophenol	29-182	32	29-182	32
3,3'-Dichlorobenzidine	1-162	56	1-162	56
3-Nitroaniline	1-120	45	1-120	45
4-Bromophenyl phenyl ether	53-127	20	53-127	20
4-Chloro-3-methylphenol	17-128	55	21-124	55
4-Chloroaniline	1-112	40	1-112	40
4-Chlorophenyl phenyl ether	25-158	27	25-158	27
4-Methyl phenol	33-118	34	25-144	33
4-Nitroaniline	1-127	49	1-127	49
4-Nitrophenol	10-148	64	10-145	34
4,6-Dinitro-2-methyl phenol	1-181	43	1-181	43
Acenaphthene	13-133	44	26-118	35
Acenaphthylene	33-145	22	33-145	23
Acetophenone	10-125	25	10-125	25
Anthracene	27-133	22	27-133	22
Atrazine	10-125	25	10-125	25
Benzaldehyde	10-125	25	10-125	25
Benzo(a)anthracene	33-143	23	33-143	23
Benzo(a)pyrene	17-163	31	17-163	31
Benzo(b)fluoranthene	24-159	28	24-159	28
Benzo(g,h,i)perylene	1-219	50	1-219	50
Benzo(k)fluoranthene	11-162	31	11-162	31
Bis(2-chloroethoxy)methane	33-184	30	33-184	30
Bis(2-chloroethyl)ether	12-158	30	12-158	30
Bis(2-ethylhexyl)phthalate	8-158	31	8-158	31
Butyl benzyl phthalate	1-152	35	1-152	35
Caprolactam	10-125	25	10-125	25
Carbazole	1-175	20	1-175	20
Chrysene	17-168	31	17-168	31
Dibenzo(a,h)anthracene	1-227	55	1-227	55
Dibenzofuran	46-117	42	46-117	42

TABLE B-13

QUALITY CONTROL LIMITS <sup>(1)</sup>  
SEMIVOLATILE COMPOUNDS  
MATRIX SPIKE / MATRIX SPIKE DUPLICATES AND SURROGATE SPIKES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 2

Compound	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
Diethyl phthalate	1-114	24	1-114	24
Dimethyl phthalate	1-112	22	1-112	22
Di-n-butyl phthalate	1-118	24	1-118	24
Di-n-octyl phthalate	4-146	29	4-146	29
Fluoranthene	26-137	23	26-137	23
Fluorene	59-121	20	59-121	20
Hexachlorobenzene	39-127	29	36-132	22
Hexachlorobutadiene	31-110	41	18-116	32
Hexachlorocyclopentadiene	1-138	54	1-138	54
Hexachloroethane	23-110	40	18-110	33
Indeno(1,2,3-cd)pyrene	1-171	37	1-171	37
Isophorone	21-196	38	21-196	38
Naphthalene	21-133	23	21-133	23
Nitrobenzene	33-112	36	10-211	50
N-Nitroso-Di-n-Propylamine	12-128	50	18-115	36
n-Nitrosodiphenylamine	5-138	68	5-138	68
Pentachlorophenol	10-144	87	10-140	56
Phenanthrene	54-120	20	54-120	20
Phenol	10-148	50	10-131	43
Pyrene	10-218	66	27-138	31
1,2-Dichlorobenzene	32-129	20	32-129	20
1,3-Dichlorobenzene	1-172	36	1-172	36
1,4-Dichlorobenzene	18-110	59	18-110	36
1,2,4-Trichlorobenzene	16-121	54	22-110	37

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-14**

**QUALITY CONTROL LIMITS <sup>(1)</sup>  
PESTICIDE COMPOUNDS  
MATRIX SPIKE / MATRIX SPIKE DUPLICATES AND SURROGATE SPIKES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS**

Compound	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
4,4'-DDD	19-157	35	42-158	39
4,4'-DDE	49-157	39	35-134	39
4,4'-DDT	23-144	42	24-145	50
Aldrin	33-122	40	19-131	33
alpha-BHC	30-130	40	30-139	54
alpha-Chlordane	26-145	65	33-142	41
beta-BHC	18-116	43	19-152	38
delta-BHC	16-142	34	26-150	44
Dieldrin	33-133	33	35-141	37
Endosulfan I	17-133	41	24-120	36
Endosulfan II	21-129	27	35-127	52
Endosulfan sulfate	22-139	34	45-142	40
Endrin	33-138	38	28-148	40
Endrin aldehyde	18-153	29	16-158	54
Endrin ketone	34-137	32	35-156	44
gamma-BHC (Lindane)	33-130	36	30-148	22
gamma-Chlordane	31-154	36	35-143	28
Heptachlor	32-128	44	25-135	32
Heptachlor epoxide	33-148	43	38-138	31
Methoxychlor	25-164	41	13-154	29
Toxaphene	30-150	30	30-150	30

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-15**

**QUALITY CONTROL LIMITS <sup>(1)</sup>**  
**PCB COMPOUNDS**  
**MATRIX SPIKE / MATRIX SPIKE DUPLICATES AND SURROGATE SPIKES**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINOIS**

Compound	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
Aroclor-1016	26-144	39	56-119	20
Aroclor-1221	---	---	---	---
Aroclor-1232	---	---	---	---
Aroclor-1242	---	---	---	---
Aroclor-1248	---	---	---	---
Aroclor-1254	---	---	---	---
Aroclor-1260	37-138	33	31-138	27

%R Percent Recovery

RPD Relative Percent Difference

NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory.

**TABLE B-16**

**QUALITY CONTROL LIMITS <sup>(1)</sup>  
METALS COMPOUNDS  
MATRIX SPIKE / MATRIX SPIKE DUPLICATES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS**

Compound	Solid Matrix		Aqueous Matrix	
	Accuracy (%R)	Precision (RPD)	Accuracy (%R)	Precision (RPD)
Aluminum	75-125	20	75-125	20
Antimony	75-125	20	75-125	20
Arsenic	75-125	20	75-125	20
Barium	75-125	20	75-125	20
Beryllium	75-125	20	75-125	20
Cadmium	75-125	20	75-125	20
Calcium	75-125	20	75-125	20
Chromium	75-125	20	75-125	20
Cobalt	75-125	20	75-125	20
Copper	75-125	20	75-125	20
Iron	75-125	20	75-125	20
Lead	75-125	20	75-125	20
Magnesium	75-125	20	75-125	20
Manganese	75-125	20	75-125	20
Mercury	75-125	20	75-125	20
Nickel	75-125	20	75-125	20
Potassium	75-125	20	75-125	20
Selenium	75-125	20	75-125	20
Silver	75-125	20	75-125	20
Sodium	75-125	20	75-125	20
Thallium	75-125	20	75-125	20
Vanadium	75-125	20	75-125	20
Zinc	75-125	20	75-125	20

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-17**  
**QUALITY CONTROL LIMITS <sup>(1)</sup>**  
**VOLATILE COMPOUNDS**  
**LABORATORY CONTROL SAMPLES**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINOIS**

Compound	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
1,1,2-Trichloro-1,2,2-trifluoroethane	10-125	10-125
1,1,1-Trichloroethane	65-144	67-131
1,1,2,2-Tetrachloroethane	58-121	59-133
1,1,2-Trichloroethane	70-130	70-130
1,1-Dichloroethane	67-129	80-113
1,1-Dichloroethene	55-142	65-119
1,2,4-Trichlorobenzene	SV	SV
1,2-Dibromo-3-Chloropropane	70-130	41-173
1,2-Dibromoethane	70-130	67-130
1,2-Dichlorobenzene	SV	SV
1,2-Dichloroethane	76-127	73-127
1,2-Dichloropropane	66-137	70-130
1,3-Dichlorobenzene	SV	SV
1,4-Dichlorobenzene	SV	SV
2-Butanone (methyl ethyl ketone)	20-155	35-156
2-Hexanone	46-134	60-130
4-Methyl-2-pentanone	46-149	62-129
Acetone	40-145	60-134
Benzene	75-129	79-116
Bromodichloromethane	66-140	68-130
Bromoform	55-135	70-140
Bromomethane	31-173	19-184
Carbon disulfide	36-130	80-116
Carbon tetrachloride	66-141	72-133
Chlorobenzene	75-127	81-115
Chloroethane	33-171	61-147
Chloroform	77-125	81-122
Chloromethane	55-146	50-143
cis-1,2-Dichloroethene	69-130	70-130
cis-1,3-Dichloropropene	60-134	80-110
Cyclohexane	10-125	10-125
Dibromochloromethane	70-130	68-139
Dichlorodifluoromethane	59-150	59-150
Ethyl acetate	NA	NA
Ethyl alcohol	NA	NA
Ethylbenzene	70-130	70-130
Isopropylbenzene	40-130	40-130
Methyl acetate	10-125	10-125
Methylcyclohexane	10-125	10-125
Methylene chloride	53-147	59-139
Methyl tert-Butyl Ether	10-125	10-125
Styrene	70-130	70-130
Tetrachloroethene	68-136	78-131
Toluene	71-130	76-119
trans-1,2-Dichloroethene	70-130	70-130
trans-1,3-Dichloropropene	49-132	80-114
Trichloroethene	66-137	80-122
Trichlorofluoromethane	75-125	75-125
Vinyl chloride	41-138	53-134
Xylenes, total	37-162	37-162

%R Percent Recovery

RPD Relative Percent Difference

NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

SV Included in the Semi-Volatile list



**TABLE B-18**  
**QUALITY CONTROL LIMITS <sup>(1)</sup>**  
**SEMIVOLATILE COMPOUNDS**  
**LABORATORY CONTROL SAMPLES**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 1 OF 2**

Compound	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
1,1'-Biphenyl	10-125	10-125
2,4,5-Trichlorophenol	40-112	10-132
2,4,6-Trichlorophenol	41-109	10-141
2,4-Dichlorophenol	39-103	10-120
2,4-Dimethylphenol	30-100	13-113
2,4-Dinitrophenol	18-152	10-185
2,4-Dinitrotoluene	48-111	47-131
2,6-Dinitrotoluene	34-128	31-115
2-Chloronaphthalene	42-104	11-121
2-Chlorophenol	43-110	19-124
2-Methylnaphthalene	42-105	14-122
2-Methylphenol (o-cresol)	36-104	16-117
2,2'-Oxybis	50-150	50-150
2-Nitroaniline	34-127	17-136
2-Nitrophenol	39-111	10-132
3,3'-Dichlorobenzidine	1-162	1-162
3-Nitroaniline	22-110	31-100
4-Bromophenyl phenyl ether	53-127	53-127
4-Chloro-3-methylphenol	43-110	29-124
4-Chloroaniline	18-100	20-100
4-Chlorophenyl phenyl ether	40-110	19-128
4-Methyl phenol	30-110	32-100
4-Nitroaniline	23-128	54-100
4-Nitrophenol	22-128	19-144
4,6-Dinitro-2-methyl phenol	37-132	10-177
Acenaphthene	44-108	39-118
Acenaphthylene	20-143	15-122
Acetophenone	10-125	10-125
Anthracene	27-133	27-133
Atrazine	10-125	10-125
Benzaldehyde	10-125	10-125
Benzo(a)anthracene	33-143	33-143
Benzo(a)pyrene	17-163	17-163
Benzo(b)fluoranthene	24-159	24-159
Benzo(g,h,i)perylene	1-219	10-219
Benzo(k)fluoranthene	11-162	11-162
Bis(2-chloroethoxy)methane	25-111	11-113
Bis(2-chloroethyl)ether	10-120	10-120
Bis(2-ethylhexyl)phthalate	8-158	10-158

**TABLE B-18**

**QUALITY CONTROL LIMITS <sup>(1)</sup>  
SEMIVOLATILE COMPOUNDS  
LABORATORY CONTROL SAMPLES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS  
PAGE 2 OF 2**

Compound	Solid Matrix Accuracy (%R)	Aqueous Matrix Accuracy (%R)
Butyl benzyl phthalate	1-152	10-152
Caprolactam	10-125	10-125
Carbazole	1-175	1-175
Chrysene	17-168	17-168
Dibenzo(a,h)anthracene	1-227	10-227
Dibenzofuran	45-107	22-119
Diethyl phthalate	38-121	62-108
Dimethyl phthalate	42-113	42-108
Di-n-butyl phthalate	1-118	10-118
Di-n-octyl phthalate	4-146	10-146
Fluoranthene	26-137	26-137
Fluorene	43-112	31-118
Hexachlorobenzene	44-126	57-128
Hexachlorobutadiene	43-100	10-142
Hexachlorocyclopentadiene	26-105	1-197
Hexachloroethane	37-105	10-138
Indeno(1,2,3-cd)pyrene	1-171	10-171
Isophorone	37-108	16-119
Naphthalene	41-102	10-129
Nitrobenzene	38-107	10-128
N-Nitroso-Di-n-Propylamine	38-110	30-115
n-Nitrosodiphenylamine	5-138	5-138
Pentachlorophenol	10-123	10-140
Phenanthrene	54-120	54-120
Phenol	35-110	10-131
Pyrene	42-122	46-130
1,2-Dichlorobenzene	40-101	10-133
1,3-Dichlorobenzene	6-131	10-131
1,4-Dichlorobenzene	38-100	28-110
1,2,4-Trichlorobenzene	45-110	31-110

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-19**

**QUALITY CONTROL LIMITS <sup>(1)</sup>  
PESTICIDE COMPOUNDS  
LABORATORY CONTROL SAMPLES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS**

<b>Compound</b>	<b>Solid Matrix Accuracy (%R)</b>	<b>Aqueous Matrix Accuracy (%R)</b>
4,4'-DDD	39-157	44-158
4,4'-DDE	26-157	32-157
4,4'-DDT	35-144	60-140
Aldrin	39-122	62-120
alpha-BHC	33-130	48-130
alpha-Chlordane	39-145	52-140
beta-BHC	51-110	47-127
delta-BHC	19-142	34-147
Dieldrin	45-128	68-130
Endosulfan I	24-113	27-120
Endosulfan II	35-124	33-127
Endosulfan sulfate	36-139	44-144
Endrin	47-133	46-137
Endrin aldehyde	27-130	42-142
Endrin ketone	49-137	44-149
gamma-BHC (Lindane)	47-130	49-137
gamma-Chlordane	33-154	47-143
Heptachlor	39-126	57-124
Heptachlor epoxide	46-125	53-135
Methoxychlor	24-161	12-154
Toxaphene	30-150	30-150

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-20**

**QUALITY CONTROL LIMITS <sup>(1)</sup>  
PCB COMPOUNDS  
LABORATORY CONTROL SAMPLES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS**

<b>Compound</b>	<b>Solid Matrix Accuracy (%R)</b>	<b>Aqueous Matrix Accuracy (%R)</b>
Aroclor-1016	49-122	61-118
Aroclor-1221	---	---
Aroclor-1232	---	---
Aroclor-1242	---	---
Aroclor-1248	---	---
Aroclor-1254	---	---
Aroclor-1260	51-127	61-124

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-21**

**QUALITY CONTROL LIMITS <sup>(1)</sup>  
METALS COMPOUNDS  
LABORATORY CONTROL SAMPLES  
SITES 7 AND 17  
NTC GREAT LAKES, ILLINOIS**

<b>Compound</b>	<b>Solid Matrix Accuracy (%R)</b>	<b>Aqueous Matrix Accuracy (%R)</b>
Aluminum	50-149	80-120
Antimony	10-209	80-120
Arsenic	74-126	80-120
Barium	77-124	80-120
Beryllium	78-122	80-120
Cadmium	76-123	80-120
Calcium	74-126	80-120
Chromium	79-120	80-120
Cobalt	79-121	80-120
Copper	81-118	80-120
Iron	58-141	80-120
Lead	76-125	80-120
Magnesium	75-125	80-120
Manganese	80-120	80-120
Mercury	57-143	80-120
Nickel	78-122	80-120
Potassium	73-127	80-120
Selenium	74-126	80-120
Silver	74-126	80-120
Sodium	68-133	80-120
Thallium	57-143	80-120
Vanadium	68-132	80-120
Zinc	77-123	80-120

%R Percent Recovery  
RPD Relative Percent Difference  
NA Not Applicable

(1) Quality control limits provided by STL Pittsburgh Laboratory

**TABLE B-22**  
**LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 1 OF 2**

Instrument	Analyses	List Maintenance, Testing and Inspection Activities	Method/SOP Reference <sup>(1)</sup>
Inductively Coupled Plasma (ICP)	Metals	This information to be provide by laboratory <u>Clean and replace pump tubing as needed</u> <u>Inspect nebulizer for clogs</u> <u>Clean air filters</u> <u>Clean Torch as needed</u>	Insert Method / SOP reference <u>Table 8.11-7 p.319 of LQM</u>
Cold Vapor Atomic Absorption (CVAA)	Mercury	This information to be provide by laboratory <u>Change Reductant tubing</u> <u>Change Dryer tubing</u> <u>Change Waste Drain tubing</u> <u>Change Liquid/Gas separator</u> <u>Change Pump head</u> <u>Change Hg lamp</u> <u>Change Pump and Process tubing</u> <u>Clean Optical Cell and External optics</u>	Insert Method / SOP reference <u>Table 8.11-9 p.320 of LQM</u>
Gas Chromatograph / Mass Spectrometer (GC/MS)	Volatiles Semivolatiles	This information to be provide by laboratory <u>Source and Quads cleaning</u> <u>Change oil in roughing pump</u> <u>Replace column</u> <u>Replace trap</u> <u>Replace Septa (VOA)</u> <u>BNA – Follows Table 8.11-12 of LQM (posted in lab)</u>	Insert Method / SOP reference <u>Table 8.11-12 p.324 of LQM</u>
Gas Chromatograph (GC)	Pesticides, PCBs	This information to be provide by laboratory <u>Table 8.11-11 p. 322 of LQM is posted in Lab and followed...</u> <u>Change Column</u> <u>Change glass T's and liners</u> <u>Change Septa</u> <u>Change Gold Seals</u>	Insert Method / SOP reference <u>Table 8.11-11 p.322 of LQM</u>

**TABLE B-22**  
**LABORATORY INSTRUMENT MAINTENANCE AND CALIBRATION**  
**SITES 7 AND 17**  
**NTC GREAT LAKES, ILLINOIS**  
**PAGE 2 OF 2**

Instrument	Analyses	List Maintenance, Testing and Inspection Activities	Method/SOP Reference <sup>(1)</sup>
High Performance Liquid Chromatography (HPLC)	PAHs	This information to be provide by laboratory <u>Replace purge valve frit and gold seal monthly</u> <u>Replace inline filters from each solvent reservoir</u> <u>Change precolumn cartridge as needed</u> <u>Change analytical column as needed</u> <u>Replace all pump seals and pistons(if scratched) 6mo.</u> <u>Replace lamp in UV detector 1000 hours</u> <u>Replace multi-channel gradient valve as needed</u> <u>Replace seat assembly and needle</u> <u>Exchange rotor seal and/or strator face as needed</u> <u>Exchange the metering seal and/or plunger as needed</u>	Insert Method / SOP reference <u>Table 8.11-4 p.317 of LQM</u>
Total Organic Carbon (TOC) Analyzer	TOC	This information to be provide by laboratory <u>Change tubing every 6mo.</u> <u>Yearly manufacturers maintenance</u> <u>Change solutions every 2mo.</u> <u>Change N2 Desiccant as needed</u> <u>Change filters every 6mo.</u>	Insert Method / SOP reference <u>Table 8.11-27 p.331 of LQM</u>
Balances	General	This information to be provide by laboratory <u>Calibrated using class "s" weights daily</u> <u>Annual manufacturer's maintenance</u>	Insert Method / SOP reference <u>Table 8.11-15 p.325 of LQM</u>
Temperature Control Devices	General	This information to be provide by laboratory <u>Temperatures checked and logged</u>	Insert Method / SOP reference <u>Table 8.11-16 and 8.11-17 p.325-326 of LQM</u>
Thermometers	General	This information to be provide by laboratory <u>Calibration vs. NIST thermometer annually</u>	Insert Method / SOP reference <u>PITT-QA-0013</u>

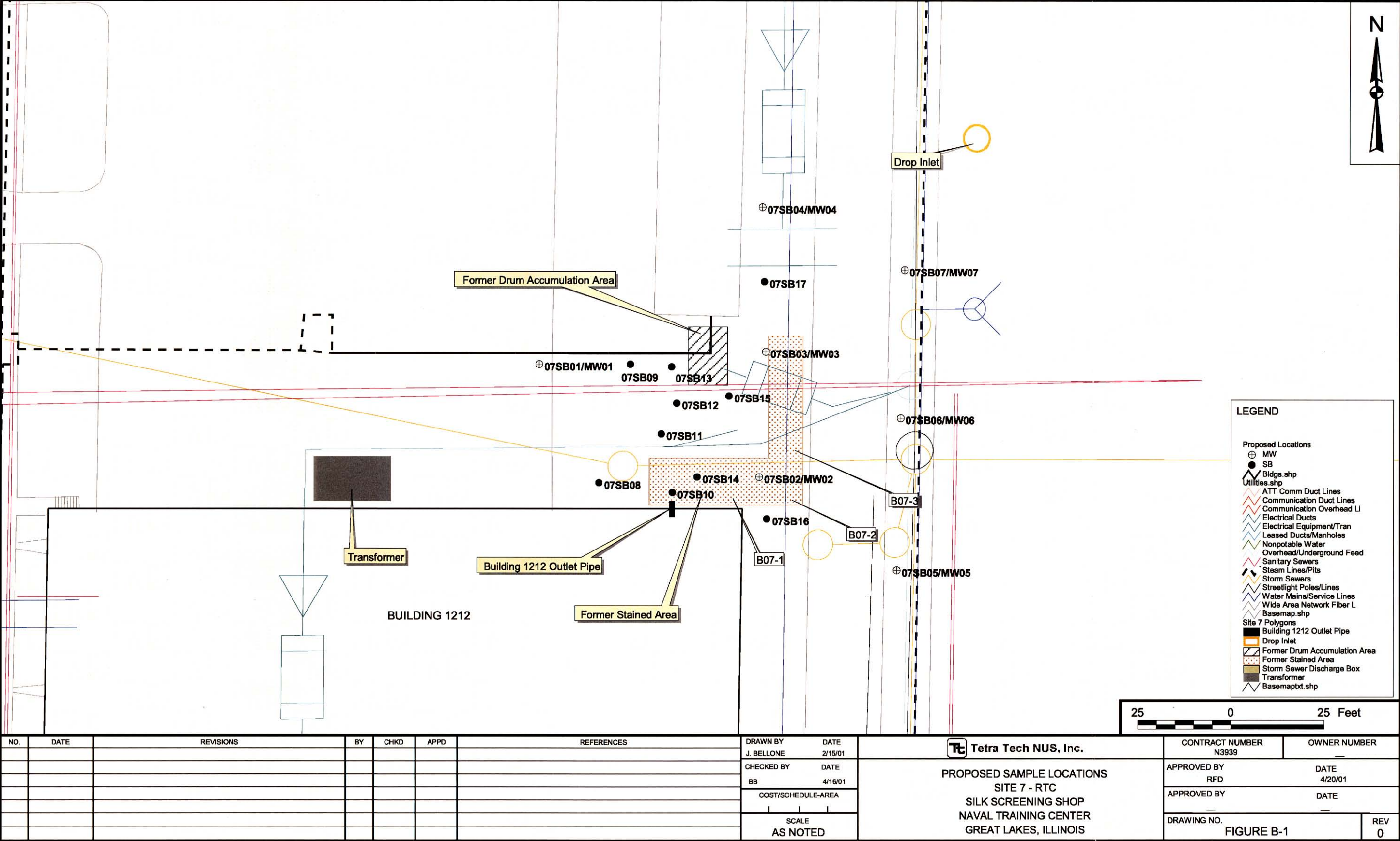
Notes:

CCV Continuing Calibration Verification  
 ICP Inductively Coupled Plasma  
 (1) Refer to Table B-12 for Method/SOP Reference

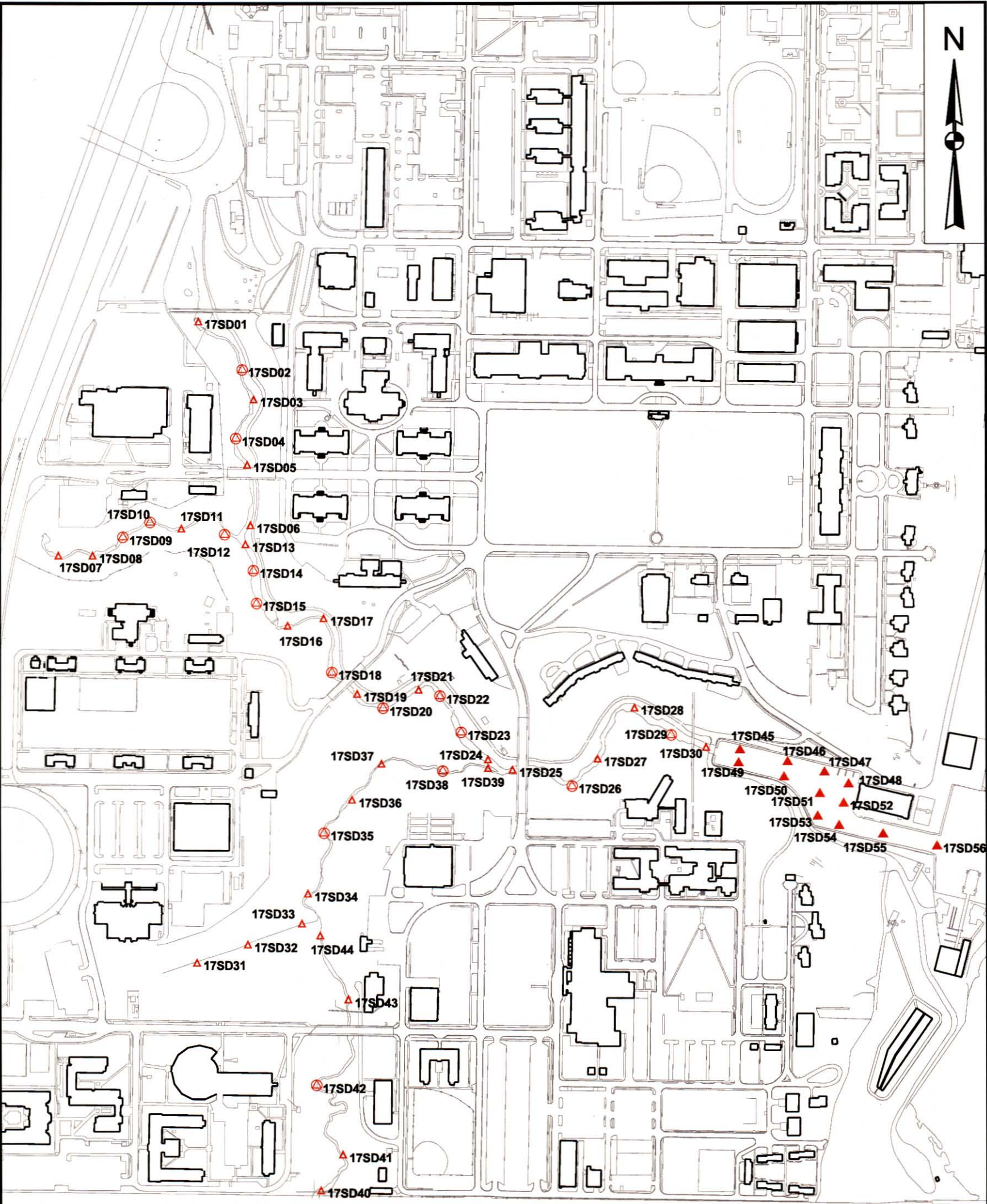
CVAA Cold Vapor Atomic Absorption  
 SOP Standard Operating Procedure

This page intentionally left blank.









LEGEND

0-4 cm

0-4 cm & 1 ft

0-4 cm

4cm-3'

3'-6'

6'-10'

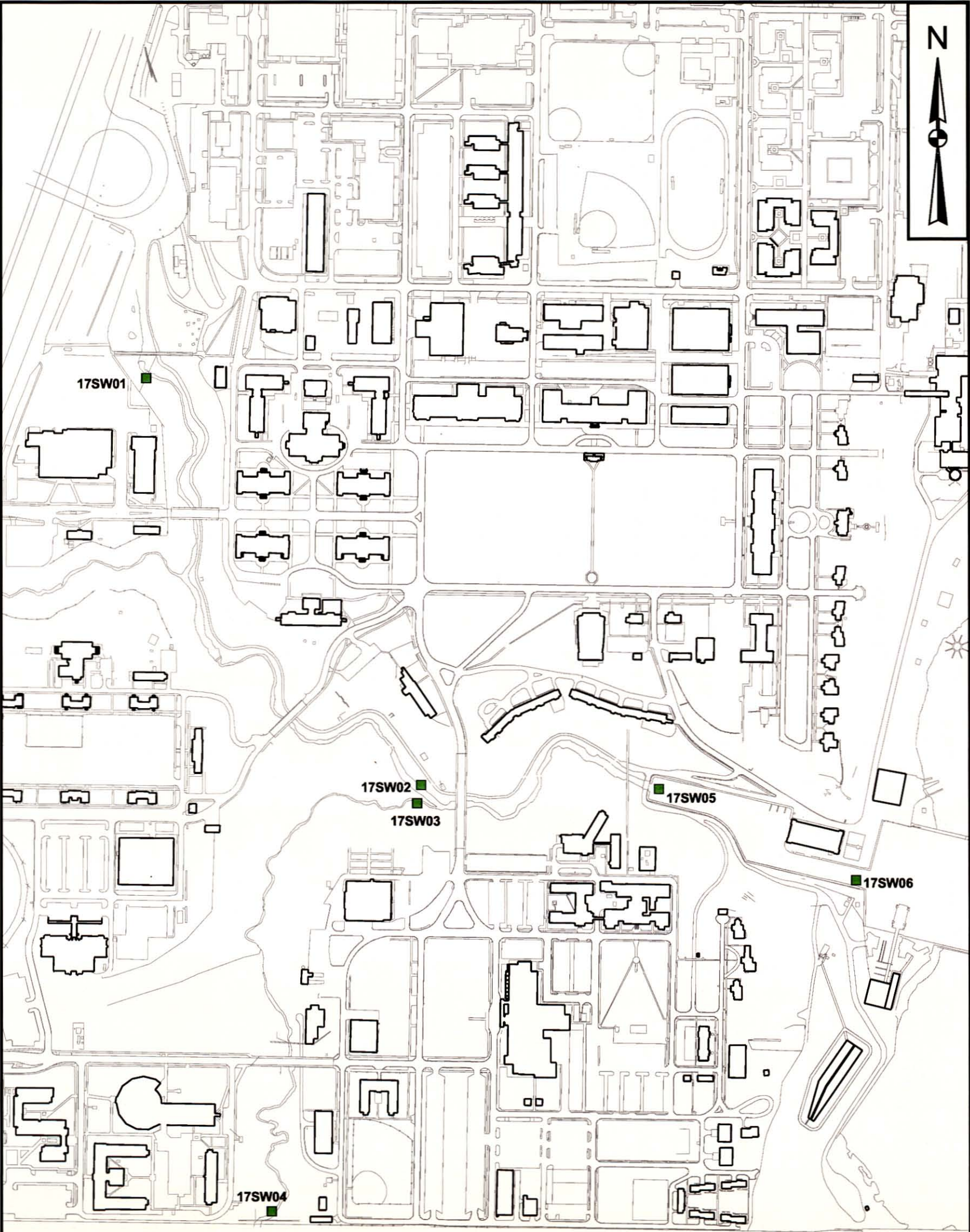
Buildings

Basemap



<div>DRAWN BY J. BELLONE</div> <div>CHECKED BY BB</div> <div>COST/SCHEDULE-AREA</div> <div>SCALE AS NOTED</div>	<div>DATE 4/5/01</div> <div>DATE 4/16/01</div> <div></div>	<div>PROPOSED SAMPLE LOCATIONS</div> <div>SITE 17 - PETTIBONE CREEK AND BOAT BASIN</div> <div>NAVAL TRAINING CENTER</div> <div>GREAT LAKES, ILLINOIS</div>	<div>CONTRACT NUMBER N3939</div> <div>APPROVED BY RFD</div> <div>APPROVED BY</div> <div>DRAWING NO. FIGURE B-2</div> <div>DATE 4/20/01</div> <div>DATE</div> <div>REV 0</div>
---	--	--	---



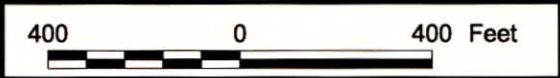


LEGEND

Proposed Surface Water Sample Location

Building

Basemap



<div>DRAWN BY J. BELLONE</div> <div>CHECKED BY BB</div> <div>COST/SCHEDULE-AREA</div> <div>SCALE AS NOTED</div>	<div></div>	<div>PROPOSED SURFACE WATER SAMPLE LOCATIONS</div> <div>SITE 17 - PETTIBONE CREEK AND BOAT BASIN</div> <div>NAVAL TRAINING CENTER</div> <div>GREAT LAKES, ILLINOIS</div>	<div>CONTRACT NUMBER</div> <div>APPROVED BY RFD</div> <div>APPROVED BY</div> <div>DRAWING NO. FIGURE B-3</div>	<div>DATE 4/30/01</div> <div>DATE</div> <div>REV 0</div>
---	-------------	--	--	--

## **C. ASSESSMENT/OVERSIGHT**

### **C1 ASSESSMENT AND RESPONSE ACTIONS**

Data reviews and technical system audits (TSAs) will be conducted periodically to make certain that work is being implemented in accordance with the approved QAPP and in an overall satisfactory manner. Some examples of pertinent audits are as follows:

- The FOL will supervise and check daily that the field observations are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is documented accurately and neatly.
- The TOM will maintain contact with the FOL and Data Validation Manager to make certain that management of the acquired data proceeds in an organized and expeditious manner.

Details regarding additional audit responsibilities, frequency, and procedures are provided in the remainder of this section. Field and laboratory performance and system audits are addressed in Section C1.A. Corrective Actions are addressed in Section C1.B.

#### **C1.A Field and Laboratory Planned Assessments**

This section presents the responsibilities, frequencies, and procedures associated with internal and external field performance and system audits.

##### **C1.A.1 Internal Field Technical System Audits**

In addition to the daily checks performed by the FOL, the TtNUS QAM or designee may conduct an independent TSA of field activities. TSAs are scheduled as part of the TtNUS SOUTHDIV Program Management Office audit program. Not every project is audited. Large projects, projects identified as having significant deficiencies or projects involving inexperienced personnel are the most likely to warrant an audit. The TOM is not involved in the project audit selection process. If a formal field audit is conducted for this study, the QAM (or designee) will be responsible for making sure that sample collection, handling, and shipping protocols, as well as equipment decontamination and field documentation procedures, are being performed in accordance with the approved QAPP and SOPs.

Internal field audits will be conducted in accordance with the following procedure:

- Prior to an audit, the auditor will prepare a detailed checklist to be used as an auditing guide. An example audit checklist is provided as part of the Supplemental Field Sampling Plan in Appendix V.
- Upon arrival at the audit location, the auditor shall conduct a pre-audit meeting with the responsible management of the organization or project to be reviewed.
- Field audits will include a review of required project documentation (logbooks, sample log sheets, etc.) and field operations (sample COC, sample handling, etc.) to evaluate completeness and compliance with applicable SOPs.
- The audit checklist will be used to record observations, including noted nonconformances.
- A formal post-audit debriefing will be conducted, and potential immediate corrective actions will be discussed.
- The auditor will generate a formal audit report that will address corrective actions. The auditor will provide this report to the TOM.
- The TOM will make sure that the corrective actions are addressed and will provide written verification of corrective action implementation to the auditor.
- The auditor will manage corrective action verification and audit closure.
- The following audit records will be maintained by the QAM:
  - Audit checklists
  - Audit reports
  - Response evaluations
  - Verification of corrective actions
  - Follow-up checklists and audit reports

#### **C1.A.2 External Field Technical System Audits**

IEPA or the Navy may conduct external field audits of subordinate organizations (as identified in the project organization chart, Figure A-1) at their discretion. If an audit is to be conducted, scheduling

should be coordinated through the TtNUS QAM to make sure that personnel and equipment are available as necessary. Personnel being audited may or may not be informed of the impending audit at the discretion and request of the auditing body. External audit procedures are at the discretion of the Navy and IEPA but shall not interfere with the safety of on site personnel.

#### **C1.A.3 Internal Laboratory Technical System Audits**

The QAO or appropriate designee of the subcontracted laboratory performs routine internal audits of the laboratory. The U.S. Navy, through the NFESC, also conducts on-site laboratory audits. On-site U.S. Navy laboratory audit procedures, as performed by a Navy contractor, include a pre-screening process that requires review of the laboratory's QA plan, analysis of performance evaluation samples, generation of data deliverables for those samples, an on-site TSA of the laboratory, and satisfactory resolution of deficiencies and findings. TtNUS holds no responsibility for such audits. Performance and system audits of laboratories are coordinated through the NFESC by an independent QA contractor. It is the responsibility of the NFESC and its contractor to make sure that the subcontracted laboratories comply with good laboratory practices and the general requirements of analytical services provided by the laboratories. The U.S. Navy completes on-site laboratory performance and system audits for each contracted laboratory on an 18-month schedule.

#### **C.1.A.4 External Laboratory Technical System Audits**

IEPA may perform external laboratory audits at their discretion. The selected laboratory is involved in various external audits and performance evaluation studies throughout the year that are required to maintain certifications and approvals by other regulatory agencies or programs. The laboratory keeps on file the corresponding certificates of qualification to perform such analyses.

External audit procedures are at the discretion of IEPA. External laboratory audits may include (but are not limited to) review of laboratory analytical procedures, laboratory on-site audits, and submission of Performance Evaluation (PE) samples to the laboratory for analysis.

#### **C1.A.5 Data Validation Audits**

##### Data Validation Reviews

Data validation protocols are reviewed routinely as part of data validation. The Data Validation Manager reviews each data validation report for consistency with project objectives.



### Data Package Review

Each laboratory data package, as part of the validation process, is reviewed for completeness. The data packages are evaluated against project-specific quality specifications as described in Section B10. Electronic data are also reviewed against the hard copy data to make certain that they are consistent.

## **C2        REPORTS TO MANAGEMENT**

QA reports to management will be provided in four primary formats during the course of this investigation: data validation reports, reports summarizing accomplishments and QA/QC issues during the field investigation, project-wide progress reports, and laboratory QA reports. The report frequency, content, preparers, and recipients are summarized in Table C-1.

Data validation reports will address major and minor laboratory noncompliances as well as noted sample matrix effects. In the event that major problems occur with the analytical laboratory (e.g., repeated or extreme holding time exceedances or calibration noncompliances, etc.), the Data Validation Manager will notify the TOM, QAM, Program Manager, Technical Coordinator, and Laboratory Services Coordinator. Such notifications (if necessary) are typically provided via internal memoranda and are placed in the project file. These reports contain a summary of the noncompliance, a synopsis of the impact on individual projects, and recommendations regarding corrective action and compensation adjustments. Corrective actions for major noncompliances are initiated at the program level.

The FOL will provide the TOM with daily verbal field progress reports during the course of the sampling event. These reports will explain accomplishments, deviations from the QAPP, upcoming activities, and a QA summary. The TOM provides a monthly progress report to the Navy that address the project budget, schedule, accomplishments, planned activities, and QA/QC issues and intended corrective actions.

The selected laboratory will provide QA reports to TtNUS if QC limits are updated or if other significant plan deviations resulted from unanticipated circumstances. Because MDLs will be included in the analytical data packages for NTC Great Lakes samples, it is not necessary for the laboratory to include updated MDLs in their QA reports unless the updates result in MDLs that different than the MDLs presented in Table A-15.

**TABLE C-1**  
**SUMMARY OF REPORTS**  
**NTC GREAT LAKES, ILLINOIS**

<b>Report</b>	<b>Content</b>	<b>Preparer</b>	<b>Frequency of Submittal</b>	<b>Recipient(s)</b>
Data Validation Report	All major and minor laboratory noncompliances as well as noted sample matrix effects.	Data Validation Manager or designee	Per SDG	TOM, project file
Major Analysis Problem Identification Report (internal memorandum)	Notification of persistent or major problems with analytical laboratory performance. Summary of the noncompliances, a synopsis of the impact on the project, and recommendations regarding corrective action and compensation adjustments.	Data Validation Manager or designee	When persistent analysis problems are detected	TOM, QAM, Program Manager, Technical Coordinator, Laboratory Services Coordinator, project file
Project Monthly Progress Report	Summary of the project budget, schedule, accomplishments, planned activities, and QA/QC issues and intended corrective actions.	TOM	Monthly for duration of project	Navy, project file
Field Progress Reports	Accomplishments, deviations from the SAP, upcoming activities, and a QA summary.	FOL	Daily, verbal, during the course of sampling	TOM
Laboratory QA Report	Summary of updated QC limits or significant deviations from planned activities/performance.	Selected Laboratory	When QC limits are updated or when other significant plan deviations result from unanticipated circumstances	TtNUS, project file; U.S. EPA Region 5, if changes in RLs/MDLs/IDLs impact DQOs

SDG = Sample Delivery Group  
TOM = Task Order Manager  
QAM = Quality Assurance Manager  
RL = Reporting Limit  
FOL = Field Operations Leader  
SAP = Sampling and Analysis Plan  
MDL = Method Detection Limit  
IDL = Instrument Detection Limit  
DQO = Data Quality Objectives



## **D. DATA VERIFICATION/VALIDATION AND USABILITY**

This section describes the process for documenting the degree to which the collected data meet the project objectives, individually and collectively for NTC Great Lakes.

### **D1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS**

#### **D1.A Sampling Design**

Project personnel will be responsible for reporting changes in the sample location and type by reporting the situation to the FOL. The TOM will be responsible for assessing a change in consultation with the QAM and the Navy RPM, and make a decision based on the potential for the situation to affect the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report [Field Task Modification Record (FTMR) form] will be initiated by the FOL. The FTMR form documents the need for the change, when the change was made, and how the change was made. The FOL will be responsible for maintaining a log of nonconformances and including nonconformance reports in the field documentation in the project files.

#### **D1.B Sample Collection Procedures**

Project personnel will be responsible for reporting changes in the sample collection procedures by reporting the situation to the FOL. The TOM will be responsible for assessing a modification to the procedure in consultation with the QAM and the Navy RPM, and make a decision based on the potential for the situation to affect the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report (FTMR form) will be initiated by the FOL. The FTMR form documents the need for the change, when the change was made, and how the change was made. The FOL will be responsible for maintaining a log of nonconformances and including nonconformance reports in the field documentation in the project files.

#### **D1.C Sample Handling**

Deviations from the sample handling procedures can occur in three areas: the field activities, transportation of the samples to the laboratory, and at the laboratory. Deviations in the sampling handling procedures during the field activities will be reported to the FOL. The FOL will correct the procedure or will contact the TOM if FOL determines that the situation warrants a reportable nonconformance. A

FTMR form reports the nonconformance and the COC and field logbooks will document the nonconformance.

The Laboratory Sample Custodian will communicate with the FOL if there is a deviation in sample handling procedures that may have occurred during the transportation of the samples to the laboratory. The FOL will correct the procedure or will contact the TOM if FOL determines that the situation warrants a reportable nonconformance. The Laboratory Sample Custodian will correct the procedure or will contact the Laboratory QAO and Laboratory Project Manager if it is determined that the situation warrants a reportable nonconformance.

The laboratory technical staff and the Laboratory Operations Manager are responsible for sample handling procedures at the laboratory and will follow the SOPs provided in Appendix IV. Deviations in the sampling handling procedures during the laboratory analysis will be reported to the Laboratory QAO and Laboratory Project Manager. The Laboratory Project Manager will correct the procedure or will contact the TOM and document the situations that warrant reportable nonconformance in accordance with the laboratory SOPs.

#### **D1.D     Analytical Procedures**

During the data validation process, it will be verified that the samples were analyzed by the appropriate methods as presented in Section B4. The data validator will evaluate deviations from the analytical procedure as required in the approved QAPP. Deviations will be detailed in the data validation memo to the TOM and appropriate qualification will be made to the affected data.

#### **D1.E     Quality Control**

The quality control limitations as presented in Section B5 should be met for the analytical data. During the data validation process, the data validator will evaluate data outside the quality control limits. Noncompliances will be detailed in the data validation memo to the TOM and appropriate qualification will be made to the affected data.

#### **D1.F     Calibration**

Data packages will include sufficient calibration data in order to determine that calibrations were performed within an acceptable time prior to generation of data; were performed in the proper sequence; included the proper number of calibration points; were performed using standards that "bracketed" the range of reported measurement results; and had acceptable linearity checks and other checks to make

sure that the measurement system was stable when the calibration was performed. During the data validation process, the data validator will identify calibration problems. Noncompliances will be detailed in the data validation memo to the TOM and appropriate qualification will be made to the affected data.

Field calibration activities are discussed in Section B.2.6 and in the Supplemental Field Sampling Plan in Appendix V. When field calibration problems are identified, project personnel will be responsible for reporting the problem to the FOL. The FOL will correct the problem or will contact the TOM if FOL determines that the situation warrants a reportable nonconformance. A FTMR form reports the nonconformance and the field logbooks will document the nonconformance.

#### **D1.G      Data Reduction and Processing**

The selected laboratory will complete data reduction in accordance with the method-specific laboratory SOPs included in Appendix IV. In addition, data will be reviewed in accordance with the laboratory QA plans. Validation will be completed using the hard copy data. After validation, the validation qualifiers will be entered into the electronic database and subjected to independent review for accuracy. During this review process, the electronic database printout also will be compared with the original data to make sure that the hard copy data and electronic data are consistent.

#### **D2      VALIDATION AND VERIFICATION METHODS**

This section describes the process that will be followed to verify and validate the project data for NTC Great Lakes.

Field measurements will not be subjected to a formal data validation process. Validation of field data will be limited to real-time inspection by the FOL of observations relative to actual site conditions and activities. In addition, field technicians will make sure that the equipment used for sample collection is performing adequately via compliance with the applicable SOPs.

Ten percent of the laboratory analytical data will be subjected to data validation to make sure that the data are of evidentiary quality. Validation of analytical data will be completed by the TtNUS Environmental Chemistry/Toxicology Department located in the TtNUS Pittsburgh office. Final review and approval of validation deliverables will be completed by the department's Data Validation Manager.

Prior to statistical analyses, analytical results will be validated against the applicable analytical methods, the SOPs included in Appendix IV, and the requirements of this QAPP. Validation of these data will

conform to the U.S. EPA Region 5 Standard Operating Procedures for Validation of CLP Inorganic and Organic Data (U.S. EPA, 1993b) and the National Functional Guidelines for Inorganic and Organic Data Review (U.S. EPA, 1993a) to the greatest extent practicable. Data validators will review the chemical analytical data packages submitted by the laboratory. The data validators will check that the data were obtained using approved methodology, that the appropriate level of QC and reporting was conducted, and that the results are in conformance with QC criteria.

On the basis of the data validation results, the data validator will generate a report describing detected data limitations. The report will be reviewed internally by the Data Validation Manager prior to submittal to the TOM. Data review will be extended beyond this routine validation by involving the project chemist, statistician, and risk assessor, as appropriate, to examine the data for anomalies. This additional review may result in more detailed inspections of the data to determine the cause of, and to rectify, individual anomalies. The impact of data qualifiers on data usability will also be assessed.

The data validation process will provide an estimate of the number of usable data points. This completeness check will be effected by computing the number of data points that are rejected relative to the total number of data points for a given analyte in a given environmental medium. Completeness is addressed in Section A7.D.

### **D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES**

The assessment of data obtained from this investigation is a critical part of determining the next step in data collection and decision making. It must be determined whether the data are of appropriate type, quality, quantity, and representativeness to support the project objectives. The effect of the loss of data deemed unacceptable for use, for whatever reason, will be evaluated on a case-by-case basis.

Field data will be examined for errors immediately after generation or within a time frame necessary to recover from such errors without sacrificing the attainment of project objectives. Laboratory data will be reviewed at the laboratory and will be examined upon receipt from the laboratory, in a series of evaluations. The first step will be a data verification and validation as described in Section D2.

After data validation, the data will be reconciled with DQOs to determine whether sufficient data of acceptable quality are available for making decisions. In concert with or in addition to the evaluations described in Section A7, a series of inspections and statistical analyses will be performed to estimate several of the data set characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as the maximum concentration, minimum concentration, number of samples

exhibiting no detectable analyte, the number of samples exhibiting detectable analytes, and the proportion of samples with detectable and undetectable analytes. The data will be presented in a tabular format. These inspections and statistical analyses will be designed to:

- Review chromatograms for anomalous baselines or other anomalous conditions that would indicate a potential analytical problem that was not identified during data validation (inspection)
- Identify deviations, if any, from the field sampling SOPs (inspection).
- Identify deviations, if any, from the laboratory analytical SOPs (inspection).
- Identify deviations, if any, from the QAPP (inspection).
- Identify deviations, if any, from the data validation process (inspection).
- Identify and explain the impacts of elevated method detection limits (MDL) and instrument detection limits (IDL) (inspection).
- Identify unusable data (e.g. data qualified as "R") (inspection).
- Evaluate project planning assumptions (inspection).
- Characterize data set distributions (by e.g., the Shapiro-Wilk W test), if enough data are available (statistical analysis).
- Identify unanticipated data set characteristics such as a laboratory variance greater than the sampling variance (i.e., ANOVA, t-test), if enough data are available (statistical analysis).
- Identify and evaluate potential data outliers (95% confidence goodness-of-fit test on probability plot data). The plotted data will be transformed, if necessary, depending on the observed distribution (statistical analysis).
- Evaluate adherence to investigation objectives and decision rules (inspection and statistical analysis, as applicable).

- Complete corrective actions (inspection).
- Evaluate effects of deviations from planned procedures and processes on the interpretation and utility of the data (inspection and statistical analysis, as applicable).
- Identify the existence of remaining data gaps (inspection/statistics).

For statistical comparisons and mathematical manipulations, analytes that are not detected at the applicable sample-specific MDL will be represented by a concentration equal to one-half the sample-specific MDL.

Statistical tests for outlier validity will be based on Procedural Guidance for Statistically Analyzing Environmental Background Data (NFEC, 1998). Potential outliers will be removed if a review of field and laboratory documents indicates that the results are true outliers. If no identifiable reason for the outlier can be identified, the datum will not be removed from the data set.

If necessary, investigation objectives may be revised in anticipation of additional data collection insofar as the changed objectives are consistent with the overall project scope and objectives.

The suitability of the given statistical test will be assessed based on the completeness of the data sets and the conditions observed at the site. For example, when a single datum value is available for soils or water samples at a given sampling location, statistical tests cannot be conducted for that individual sampling location. However, pooling of data across sampling locations may be possible and, if logical to do so, may be implemented at the discretion of the TOM. For example, when evaluating chemicals of potential concern (COPCs), multiple soil sample results of a given depth and grain size within a depositional environment may be pooled for statistical comparison to the background data set from soil of the same depth, grain size and depositional environment. Statistical testing will generally be conducted at the 5% significance level. Statistical testing at other significance levels may also be warranted to provide perspective on the results of testing at 5% significance. If other significance levels are used, they will be supported with rationales for their use.

## REFERENCES

Biegeleisen, J.I., 1971. Screen Printing: A Contemporary Guide to the Techniques of Screen Printing for Artists, Designers, and Craftsmen. Watson-Guptill Publications. New York, NY.

Brown & Root Environmental, 1996. Technical Memorandum for Support of the Relative Risk Evaluation at Various Activities, Southern Division Naval Facilities Engineering Command, North Charleston, South Carolina, March.

Dames & Moore, 1991. Technical Memorandum on the Remedial Investigation Verification Step for the Naval Training Center Great Lakes, NEESA 21-011, Volume 2A, Main Report and Appendices A-F, Naval Energy and Environmental Support Activity, Port Hueneme, California 93043, November.

DoD, 2000. Department of Defense Quality Systems Manual for Environmental Laboratories, Department of Defense Environmental Data Quality Workgroup, Department of Navy, Lead Service, Version 1, October.

Eisenberg, J., and Kafka, F.J., 1957. Silk Screen Printing. McKnight & McKnight Publishing Co. Bloomington, IL.

Halliburton NUS Environmental Corporation, 1994. Draft Geophysical Investigation Report, Great Lakes Naval Training Center, Great Lakes, Illinois, Northern Division Naval Facilities Engineering Command, Lester, Pennsylvania, August.

IEPA, 1996. Tiered Approach to Corrective Action Objectives (TACO). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online March 2001.

Kosloff, Albert M.A., 1950. Screen Process Printing. The Signs of the Times Publishing Co. Cincinnati, OH.

Kosloff, Albert M.A., 1962. Photographic Screen Process Printing. The Signs of the Times Publishing Co. Cincinnati, OH.

Kosloff, Albert M.A., 1966. Textile Screen Printing. The Signs of the Times Publishing Co. Cincinnati, OH.

NFEC, 1998. Procedural Guidance for Statistically Analyzing Environmental Background Data, Naval Facilities Engineering Command.

NFESC, 1999. Navy Installation Restoration Chemical Data Quality Manual (IRCDQM), Naval Facilities Engineering Support Center, Port Hueneme, California, September.

U.S. EPA, 1986. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. SW-846, 3<sup>rd</sup> ed. with updates up to and including Update III.

U.S. EPA, 1993a. Region 5 Standard Operating Procedure for Validation of CLP Inorganic Data. U.S. EPA Region 5 Environmental Sciences Division, Central Regional Laboratory, Chicago, IL, September.

U.S. EPA, 1993b. Region 5 Standard Operating Procedure for Validation of CLP Organic Data. U.S. EPA Region 5 Environmental Sciences Division, Central Regional Laboratory, Chicago, IL, August.

U.S. EPA, 1994a. Draft Cleaner Technologies Substitutes Assessment (CTSA): Screen Reclamation. <http://www.epa.gov/opptintr/dfe/screenprinting/ctsa/index.html>

U.S. EPA, 1994b. Laboratory Program National Functional Guidelines for Inorganic Data Review. EPA-540/R-94/013: Office of Solid Waste and Emergency Response, Washington, DC, February.

U.S. EPA, 1994c. Laboratory Program National Functional Guidelines for Organic Data Review. EPA-540/R-94/012. Office of Solid Waste and Emergency Response, Washington, DC, February.

U.S. EPA, 1998. RCRA In Focus. <http://www.epa.gov/epaoswer/hazwaste/id/infocus/printing.pdf>

U.S. EPA, 1999. U. S. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October.

U.S. EPA, 2000. Guidance for the Data Quality Objective Process [EPA/600/R-96/055], U.S. EPA Office of Environmental Information, August.

U.S. EPA, 2000b. Region 9 Preliminary Remediation Goals (PRGs), U.S. EPA Region 9, 75 Hawthorne Street, San Francisco, California, 94105, November.



U.S. EPA, 2000c. Instructions on the Preparation of a Superfund Division QAPP. U.S. EPA Region 5, Chicago, IL. June.

## **APPENDIX I**

### **HUMAN HEALTH RISK ASSESSMENT WORK PLAN**

## **I.1 SITE 7 RTC SILK SCREENING SHOP**

## **SITE 7 - HUMAN HEALTH RISK ASSESSMENT METHODOLOGY**

### **TABLE OF CONTENTS**

#### **1.0 DATA EVALUATION**

- 1.1 DATA USABILITY
- 1.2 SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPCS)
  - 1.2.1 COPC Screening Criteria
  - 1.2.2 Lead as a COPC
  - 1.2.3 Essential Nutrients and Chemicals without Toxicity Criteria
  - 1.2.4 Determination of Site-Related Chemicals
- 1.3 COPC SUMMARY SCREENING TABLES

#### **2.0 EXPOSURE ASSESSMENT**

- 2.1 CONCEPTUAL SITE MODEL (CSM)
  - 2.1.1 Site Sources of Contamination
  - 2.1.2 Contaminant Release Mechanisms and Transport/Migration Pathways
  - 2.1.3 Exposure Routes
  - 2.1.4 Potential Receptors
- 2.2 CENTRAL TENDENCY EXPOSURE VS. REASONABLE MAXIMUM EXPOSURE
- 2.3 EXPOSURE POINT CONCENTRATIONS (EPCS)
- 2.4 CHEMICAL INTAKE ESTIMATION
  - 2.4.1 Dermal Contact with Soil
  - 2.4.2 Incidental Ingestion of Soil
  - 2.4.3 Dermal Contact with Groundwater
  - 2.4.4 Inhalation of Air Containing Fugitive Dust/Volatiles Emitted from Soil
  - 2.4.5 Inhalation of Air Containing Volatiles Emitted from Groundwater
- 2.5 EXPOSURE TO LEAD

#### **3.0 TOXICITY ASSESSMENT**

- 3.1 TOXICITY CRITERIA
- 3.2 TOXICITY CRITERIA FOR DERMAL EXPOSURE
- 3.3 TOXICITY CRITERIA FOR CARCINOGENIC EFFECTS OF POLYNUCLEAR AROMATIC HYDROCARBONS (PAHS)
- 3.4 TOXICITY CRITERIA FOR CHROMIUM
- 3.5 TOXICITY PROFILES

#### **4.0 RISK CHARACTERIZATION**

- 4.1 QUANTITATIVE ANALYSIS
- 4.2 COMPARISON OF QUANTITATIVE RISK ESTIMATES TO BENCHMARKS
- 4.3 QUALITATIVE ANALYSIS

#### **5.0 UNCERTAINTY ANALYSIS**

- 5.1 UNCERTAINTY IN DATA EVALUATION
- 5.2 UNCERTAINTY IN THE EXPOSURE ASSESSMENT
- 5.3 UNCERTAINTY IN THE TOXICITY ASSESSMENT
- 5.4 UNCERTAINTY IN THE RISK CHARACTERIZATION

## **TABLES**

### **NUMBER**

- 1 Occurrence, Distribution and Selection of Chemicals of Potential Concern
- 2 Exposure Routes for Quantitative Evaluation
- 3 Values Used for Daily Intake Calculations for Exposure of Construction Workers to Surface / Subsurface Soil
- 4 Values Used for Daily Intake Calculations for Exposure of Maintenance Workers to Soil
- 5 Values Used for Daily Intake Calculations for Exposure of Adolescent Trespassers to Soil
- 6 Values Used for Daily Intake Calculations for Exposure of Future Civilian Adult Residents to Surface / Subsurface Soil
- 7 Values Used for Daily Intake Calculations for Exposure of Future Civilian Child Residents to Surface / Subsurface Soil
- 8 Values Used for Daily Intake Calculations for Exposure of Future Military Adult Residents to Surface / Subsurface Soil
- 9 Values Used for Daily Intake Calculations for Exposure of Future Military Child Residents to Surface / Subsurface Soil
- 10 Values Used for Daily Intake Calculations for exposure of Construction Workers to Groundwater

## **FIGURES**

### **NUMBER**

- 1 Human Health Conceptual Site Model

## SITE 7 - HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

This section of the QAPP outlines the general methodologies and procedures that will be used to conduct a Baseline Human Health Risk Assessment for Site 7, the Recruit Training Center (RTC) Silk Screening Shop (Building 1212) located at Naval Training Center (NTC) Great Lakes. The objective of the risk assessment is to determine whether detected concentrations of chemicals at the site pose a significant threat to potential human receptors under current and/or future land use. The potential risks to human receptors will be estimated based on the assumption that no further actions are taken to control contaminant releases.

The following risk assessment guidance documents were used to develop the framework for the Baseline Human Health Risk Assessment:

- U.S. EPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C.
- U.S. EPA, 1991a. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. Washington, D.C.
- U.S. EPA, 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication No. 9285.7-081. Washington, D.C.
- U.S. EPA, 1993a. Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C.
- U.S. EPA, 1996a. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response. Washington, D.C.
- U.S. EPA, 1997a. Exposure Factors Handbook. EPA/600/P-95/002Fa. Office of Health and Environmental Assessment, Washington, D.C.

- U.S. EPA, 2000a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance, Dermal Risk Assessment) Interim Guidance. Office of Emergency and Remedial Response, Washington, D.C.
- IEPA, 1996. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online March, 2001.
- Department of the Navy, 2001, Conducting Human Health Risk Assessments under the Environmental Restoration Program. Ser N453E/1U595168. Washington, D.C.

The risk assessment will be structured and reported according to the guidelines of the Risk Assessment for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D) (U.S. EPA, 1998).

A Baseline Human Health Risk Assessment has five components: (1) Data Evaluation, (2) Exposure Assessment, (3) Toxicity Assessment, (4) Risk Characterization, and (5) Uncertainty Analysis.

Three major aspects of chemical contamination and environmental fate and transport must be considered to evaluate potential risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action, (2) potential exposure points must exist, and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of these factors is absent, the exposure route is regarded as incomplete, and no potential risks will be considered to exist for human receptors.

## **1.0 DATA EVALUATION**

Data evaluation, the first component of a Human Health Risk Assessment, involves the compilation and evaluation of analytical data. The main objective of the data evaluation is to develop a media-specific list of chemical of potential concern (COPCs), that will be used to quantitatively determine potential human health risks for site media.

A "data evaluation/useability" section will precede the actual risk assessment in the report. The evaluation will address such issues as the adequacy of detection limits achieved in the environmental investigations. As noted in RAGS Part D, "data quality is an important component of the risk assessment and the data quality should be documented." Data quality will be evaluated as follows:

- To the extent available, the results of data validation conducted for the data sets used in the baseline risk assessment will be summarized and presented.
- To the extent that the information is available, the "Data Useability Worksheet" suggested in RAGS Part D will be completed.
- The data evaluation narrative will discuss data quality issues identified during the completion of the "Data Useability Worksheet."

### 1.1 Data Usability

Data collected during the proposed field investigation will be used to assess risks to potential human receptors. The analytical data used in the quantitative estimation of potential risks will be subjected to data validation. A discussion of data validation protocol is provided in the QAPP. As stated above, a Data Evaluation/Useability Report will be generated for the results of the field investigation. This report will provide information on precision, accuracy, representativeness, completeness, and comparability. A brief summary of the results of the data validation also will be included.

Quantitative or qualitative analytical results from the target analyte lists for the proposed field investigation will be used in the risk evaluation. Field measurements, data regarded as unreliable (i.e., qualified as "R" during the data validation process), and results of Tentatively Identified Compound (TIC) analyses will not be used in the quantitative risk assessment. However, these data may be used to substantiate the conclusions of the quantitative risk analysis.

Because of uncertainties associated with data quality, historical data collected during previous investigations will not be used to quantitatively assess potential risks at Site 7. The quality of the historical data is not completely documented and some of the data may not have been validated. However, these data may be used in a qualitative fashion to support the conclusions of the quantitative risk analysis. The proposed field investigation was developed to be comprehensive (i.e., locations sampled historically, as well as locations selected to close data gaps, were included); thus, the uncertainty associated with the elimination of the historical data from the quantitative risk assessment is not expected to be significant.



## **1.2 Selection of Chemicals of Potential Concern (COPCs)**

COPCs are selected through a qualitative screening process in order to limit the number of chemicals and exposure routes quantitatively evaluated in the Baseline Human Health Risk Assessment to only those site-related constituents that dominate overall potential risks. Screening by use of risk-based concentrations and Illinois Environmental Protection Agency (IEPA) background levels will be used to focus the risk assessment on meaningful chemicals and exposure routes.

In general, a chemical will be selected as a COPC and retained for further quantitative risk evaluation if (1) the maximum detection in a sampled medium exceeds the lowest risk-based concentration and (2) the chemical is determined to be present at concentrations exceeding background. Chemicals eliminated from further evaluation at this time are assumed to present nominal risks to potential human receptors.

### **1.2.1 COPC Screening Criteria**

Several screening criteria will be used to identify COPCs for Site 7. Screening concentrations based on risk-based cleanup objectives developed by IEPA (IEPA, 1996) and risk-based concentrations developed by U.S. Environmental Protection Agency (U.S. EPA) Region 9 (referred to as PRGs) (U.S. EPA, 2000b) will be used, as well as other U.S. EPA criteria. The risk-based screening concentrations correspond to a systemic hazard quotient of 0.1 for noncarcinogens or an incremental lifetime cancer risk of  $1 \times 10^{-6}$  for carcinogens. Note that the IEPA and Region 9 Preliminary Remediation Goals (PRGs) for noncarcinogens are based on a hazard quotient of 1.0 while the screening concentrations will be based on a hazard quotient of 0.1. The screening concentrations are based on a hazard quotient of 0.1 so that additive noncarcinogenic risks for the chemicals do not exceed 1.0. The screening levels to be used for each medium in the risk assessment are briefly discussed below.

#### **Screening Levels for Soil**

The following criteria will be used to select soil COPCs (surface and subsurface soil):

- IEPA Tier 1 Soil Remediation Objectives for Residential Properties (IEPA, 1996). These include remediation objectives for the soil ingestion exposure route and for the inhalation exposure route.
- U.S. EPA Region 9 PRGs for Residential Soil (U.S. EPA, 2000b).
- U.S. EPA Generic Soil Screening Levels (SSLs) for Transfers from Soil to Air (U.S. EPA, 1996a).

If the maximum concentration of a constituent exceeds any of these criteria and if the constituent is considered to be present at concentrations greater than the concentrations of chemicals in background soils, the chemical will be selected as a COPC. The procedures for the elimination of chemicals on the basis of background concentrations will follow current U.S. Navy policy provided in the Navy Interim Final Policy on the Use of Background Chemical Levels (Department of the Navy, 2000). At the present time, facility background concentrations for naturally occurring or anthropogenic chemicals have not been determined for NTC Great Lakes. Therefore, maximum soil concentrations will be compared to the concentrations of inorganic chemicals provided by IEPA in Appendix A, Table G of TACO (IEPA, 1996). A diagram of the COPC selection process for surface and subsurface soil is provided in Section A of the QAPP.

To evaluate the potential for chemicals detected in soil to impact groundwater, maximum chemical concentrations will be compared to SSLs for migration to groundwater. The comparisons will be presented in separate tables (from the COPC tables) and will not be used to select COPCS for soil. The migration from soil to groundwater comparisons will be made using the following criteria:

- IEPA Tier 1 Soil Remediation Objectives for Residential Properties for the Soil Component of the Groundwater Ingestion Exposure Route (IEPA, 1996).
- U.S. EPA Generic Soil Screening Levels for Migration to Groundwater (U.S. EPA, 1996a).
- U.S. EPA Region 3 Soil Screening Levels for Migration to Groundwater (U.S. EPA, 2000c).

Results of the comparison will be discussed qualitatively in the risk assessment.

Because of the different exposure scenarios for potential human receptors, COPCs will be identified for surface and subsurface soil. Surface soil will be defined as soil collected from 0 to 1 feet below ground surface (bgs). Subsurface soil will be defined as soil collected from depths greater than 1 foot bgs. Future residents and construction workers will be assumed to be exposed to surface soil and combined surface/subsurface soil. Maintenance workers and trespassers will be assumed to be exposed to surface soil only. Exposure to combined surface/subsurface soil for future residents will be evaluated to account for the possibility that subsurface soil may be brought to the surface in a future excavation and mixed with surface soil.

In addition to screening, the comparison of site soil data to U.S. EPA Generic Inhalation SSLs for transfers from soil to air will be used to identify whether a quantitative analysis of this exposure pathway is warranted. If the maximum soil concentration of a chemical exceeds the Inhalation SSL, a quantitative evaluation of potential risks from inhalation will be performed. Otherwise, the risks associated with the

inhalation pathway will be considered insignificant, and the exposure pathway will be eliminated from further evaluation.

#### Screening Concentrations for Groundwater

Direct exposure to groundwater at Site 7 is not expected to occur under current and/or future land uses because the facility and the area surrounding the facility are supplied by public water and there are no drinking water wells located immediately downgradient of the site. However, industrial exposure to groundwater will be evaluated to account for the possibility that future construction workers may contact groundwater during excavation or construction activities. Although the groundwater is not a source of drinking water, the following criteria will be conservatively used to select COPCs for groundwater:

- IEPA Tier 1 Groundwater Remediation Objectives for Class 1 Groundwater (IEPA, 1996).
- U.S. EPA Region 9 PRGs for Tap Water (U.S. EPA, 2000b).
- U.S. EPA MCLs (U.S. EPA, 2000d).

If the maximum concentration of a constituent exceeds any of these criteria, the chemical will be selected as a COPC and carried through to the quantitative risk assessment.

#### Surface Water and Sediment

Potential risks from exposure to surface water and sediment at Site 7 will not be evaluated because surface water and sediment do not exist on the site.

#### **1.2.2 Lead as a COPC**

Limited criteria are available to evaluate the potential risks associated with lead. There are no risk-based concentrations for this chemical because the U.S. EPA has not derived toxicity values for lead. However, recommended screening levels available for lead in soil are used to indicate the need for response activities. Guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the Office of Solid Waste and Emergency Response (OSWER) recommend 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting, where children are frequently present (U.S. EPA, 1994a). OPPTS identifies 2,000 to 5,000 mg/kg as an appropriate range for areas where contact with soil by children in a residential setting is less frequent.

At this time, no screening level is available for non-residential areas involving adult and adolescent exposure. Therefore, the 400 mg/kg residential soil value will be used as a screening level for non-

residential receptors (This is conservative because data from the adult lead model (U.S. EPA, 1996b) indicates that a screening level of 750 mg/kg is more appropriate for non-residential exposure situations). The Safe Drinking Water Act Action Level of 15 µg/L (U.S. EPA, 2000d) will be used as the screening level for lead in groundwater.

#### **1.2.3 Essential Nutrients and Chemicals without Toxicity Criteria**

The essential nutrients calcium, magnesium, potassium, and sodium will not be identified as COPCs for Site 7. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses. In addition, risk-based COPC screening levels cannot be derived for the essential nutrients because of the lack of available toxicity criteria. Some of the constituents used in the silk screening process (i.e., alcohols, photographic emulsions, etc) also lack toxicity criteria. These chemicals will not be selected as COPCs as they can not be addressed during the quantitative risk assessment. However, these chemicals will be mentioned in the data evaluation section, after the identification of COPCs, and qualitatively addressed in the uncertainty section of the risk assessment, if they are detected.

#### **1.2.4 Determination of Site-Related Chemicals**

Chemicals in soil found at concentrations indicative of background concentrations are not considered to be site-related contaminants and will not be retained as COPCs for the quantitative risk assessment. In order to determine whether inorganic chemicals are present at concentrations greater than background, the maximum concentrations of inorganic chemicals will be compared to the concentrations in background soils provided in Appendix A, Table G of IEPA Title 35 Part 742 of TACO (IEPA, 1996).

Only inorganic chemicals will be eliminated based on background data for soil. Some organic compounds are often found at low concentrations in background samples and the detected concentrations usually reflect non-site related, anthropogenic sources of contamination (e.g., automobile exhausts). The detected organic compounds will be regarded as site-related for purposes of COPC selection. However, historical information and information from this investigation will be reviewed in the risk assessment to determine whether the organic chemicals present in site samples are attributable to site-related activities or other anthropogenic sources. This evaluation will be made by comparing site data with background data found in the literature. The results of this qualitative analysis will be discussed in the uncertainty section of the risk assessment.

### **1.3 COPC Summary Screening Tables**

Media-specific tables summarizing the selection of COPCs will be included in the risk assessment. The tables will be prepared according to the guidelines established for preparation of Standard Table 2 of the RAGS Part D guidance. An example format of a typical COPC selection table is provided as Table 1.

## **2.0 EXPOSURE ASSESSMENT**

The exposure assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations and applicable exposure pathways, determine concentrations of COPCs to which receptors might be exposed, and estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures at Site 7 will be determined based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components: (1) a source of chemicals that can be released to the environment, (2) a route of contaminant transport through an environmental medium, and (3) an exposure or contact point for a human receptor.

### **2.1 Conceptual Site Model (CSM)**

The development of a CSM is an essential component of the exposure assessment. The CSM integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors to be evaluated in the risk assessment. A well-developed CSM will allow for a better understanding of the risks at a site and will aid the risk managers in the identification of the potential need for remediation. The site-specific CSM for Site 7 is presented in this section and illustrated in Figure 1. The model was used to develop the proposed field investigations so that the data collected meet the needs of the risk assessment. The CSM depicts the relationships among the following elements:

- Site sources of contamination
- Contaminant release mechanisms
- Transport/migration pathways
- Exposure routes
- Potential receptors

The CSM will be refined during the risk assessment process using the data and information collected as part of the proposed field investigations. Table 2 presents a summary of the exposure routes that will be addressed quantitatively for each human receptor. A summary discussion of the CSM for Site 7 is provided in Section A of the QAPP.

The elements of the CSM as they pertain to Site 7 are presented in the following sections.

#### **2.1.1 Site Sources of Contamination**

Site 7 is bounded on the south by Building 1212, on the west by Indiana Street, on the north by 8th Avenue, and on the east by Ohio Street. It is primarily covered with asphalt and serves as a parking lot. Two fuel above ground storage tanks (ASTs) were located in a fenced area near Ohio Street, across from the former silk-screening shop drain. To the north of the ASTs lies a fenced, unpaved storage area for trailers, equipment, soils, and logs, which extends northward to 8th Avenue. A concrete vault, housing steam pipes, is located between the AST area and Ohio Street. Underground steam lines reportedly run in a north-south and east-west direction from the vault.

The RTC Silk-Screening Shop was located in the RTC Training Aids Branch in Building 1212 since 1943. Various flags and banners that recruits use during parades, graduation, etc. are made in this shop. While specific materials have changed over the years, they include water and oil-based lacquers and enamels, mineral spirits, acetone, bleach, linseed oil, alcohol, thinners, direct photographic emulsion, and ink products. Thinners were used at the rate of 3 gallons per week during heavy work periods and virtually all left the building via the wash booth drain. Photographic emulsion was used at the rate of approximately 5 gallons per year, all of which was washed out of the drain. During busy periods, approximately 200 gallons per week of wash wastes were flushed out of the drain and onto the ground. The waste flowed out of the drain at a rate of 1,400 gallons per year. Upwards of 20,000 gallons of process waste may have been released in this area. Silk screen wastes are no longer released to the environment.

From at least 1972 to 1985, the finished silk screens were washed in a booth located in the northeast corner of Building 1212, and the wastes were allowed to pass through a drain that emptied onto the unpaved ground immediately outside of the building. The 2-inch drain was located in the bottom of the wash booth, penetrated the exterior wall, and ended in mid-air. Now, wastes are disposed of in a 55-gallon drum that is emptied by a private contractor hired through DRMO.

The ground surrounding the outlet (an area approximately 3 feet by 15 feet) appeared obviously stained during a research study in June 1985. At the northeast corner of Building 1212 was a less obvious stain leading away from the building, perpendicular to the northern outside wall. Together these strips formed an "L"-shaped stain that continued into the dirt road leading behind the building. This L-shaped area is the area of known contaminant releases. The Initial Assessment Study (IAS) reported that pools of water formed in this area during heavy discharge periods. The pooled water would infiltrate the soil, be washed away by precipitation, or evaporate. Building 1212 footers appear to extend to about 6.5 feet below ground surface, so contaminants would have to have permeated to at least that depth before migrating underneath the building. Less obvious staining continued north and east in to the dirt road behind the building where, reportedly, the effluent often formed pools during periods of heavy discharge. These pools remained until they infiltrated the soil, were flushed away by precipitation, or evaporated.

Soil in this area is classified in the Initial Assessment Study (IAS) as slowly to moderately permeable silty loam or filled or developed land. No site-specific soil permeability information is available. As recently as November 1991, the ground outside Building 1212 was covered with gravel. The Building 1212 exterior grounds are currently covered with asphalt and the asphalted area serves as a parking lot. Contaminant migration may have occurred through the drop inlets located near Building 1212 that connect to storm sewers leading underneath Ohio Street to the east.

The two 500 gallon ASTs were located about 35 feet northwest of the northeast corner of Building 1212. One was used for diesel fuel storage; the other was used for gasoline storage. A petroleum release from one of the tanks in 1992 is documented. It isn't clear from which tank the release occurred. During the excavation and removal of the gasoline-contaminated soils, a petroleum-like product was encountered at approximately 2 feet below grade and halted the cleanup operation. The partially-excavated area was then backfilled with clean material. Contaminated soil was excavated at and around the release point down to clean soil, then another 6 inches beyond, at which point a green viscous material of unknown nature and extent was encountered. The viscous material was not remediated but the excavation was filled in with clean material. A WWII vintage gasoline station may also have been located in the area of Site 7. Underground storage tanks may be located in the north-central part of the existing parking lot. A geophysical investigation of Site 7 was conducted by Rust Environment and Infrastructure (Rust E & I, 1994). The Rust report stated that "a group of anomalies...having radar signature strength sufficient to indicate a potential buried metallic object or objects. Because none of these anomalies shows a typical tank signature, we cannot be conclusive in identification." The Rust report concluded that further investigation of the area was warranted.

### **2.1.2 Contaminant Release Mechanisms and Transport/Migration Pathways**

As described in Section A5, past activities at the site may have resulted in contaminant releases to the surrounding environment. Wastewater containing paints, inks, water- and oil-based lacquers, enamels, mineral spirits, acetone, thinners, and photographic emulsions from the RTC Silk Screening Shop water booth drained directly onto the unpaved ground outside the building. Surface soil samples were collected at Site 7 as part of the Verification Step Program conducted in 1991. The samples were analyzed for VOCs, silver, chromium (total), cadmium, and lead, based on the types of material thought to have been disposed with the washwater. Three VOCs (acetone, methylene chloride, and toluene) and three metals [cadmium, chromium (total), and lead] were detected in the soil samples. The presence of the three VOCs was thought to have been due to field or laboratory contamination and the concentrations of cadmium (1.14 to 1.94 mg/kg) and total chromium (20.51 to 32.02 mg/kg) were considered to be within naturally occurring levels.

Based on information regarding past practices and chemical releases at the site, plausible contaminant release and migration mechanisms include the following:

- Transport of silk screening chemicals in wash water deposited on surface soil, to subsurface soil and groundwater via infiltration, percolation, and migration within the shallow groundwater aquifer.
- Migration of fugitive dusts and VOCs from surface and subsurface soil if construction/excavation activities occur in the future.

### **2.1.3 Exposure Routes**

The manner in which a receptor comes into contact with contaminants is generally the result of interactions between a receptor's behavior or lifestyle and contaminated medium. Potential receptors could come into contact with potentially contaminated soil (surface and subsurface), groundwater, and air. Brief explanations of the potential routes of exposure per media are provided in this section.

#### Soil

Exposure to contaminated soil at the site under current land use is expected to be limited because a large portion of the site is paved. Exposure to chemicals in soil at the site could occur under future land use if the soil were to be uncovered (e.g., during excavation). If this were to occur, a receptor may be exposed to soil via inadvertent ingestion of a small amount of soil or via dermal absorption of contaminants from the soil.



### Groundwater

As stated previously, direct exposure to groundwater at Site 7 is not expected to occur under current and/or future land uses because the facility and the area surrounding the facility are supplied by public water and there are no drinking water wells located immediately downgradient of the site. However, a future construction workers scenario will be evaluated for dermal contact with groundwater to account for the possibility that they may contact groundwater during future excavation activities. Inhalation of chemicals in groundwater will be considered only if volatile compounds are identified as constituents of concern for groundwater at the site.

### Air

This exposure pathway is based on the assumption that a receptor inhales air that contains suspended particulates and volatile organic vapors originating from soil. This pathway is not expected to be significant for Site 7 because a large portion of the site is paved. Exposure to fugitive dust and vapors would be an applicable exposure pathway only if the soil at the site were to be uncovered in future construction or excavation activities. To account for this possibility, the air pathway will be evaluated semiquantitatively by comparing maximum chemical concentrations in soil to U.S. EPA Generic SSLs for inhalation. If the maximum concentration of a chemical exceeds its SSL, potential risks from inhalation of that chemical will be quantitatively evaluated in the risk assessment according to guidance set forth in RAGS Part A (U.S. EPA, 1989), RAGS Part B (U.S. EPA, 1991b), and the U.S. EPA's Soil Screening Guidance (U.S. EPA, 1996a).

#### **2.1.4 Potential Receptors**

NTC Great Lakes is an active facility and will remain so for the foreseeable future. Under current land use, access to and use of Site 7 is primarily limited to military personnel. However, to aid in risk management decisions, the risk assessment will also consider potential receptors, such as future residents, who might be exposed to contaminants in site media or migrating from the site. The potential receptors have been identified by analyzing current land use practices, potential future land uses, and the identified areas of contamination in order to focus the risk assessment on potential site-related exposures. The general receptor classes include:

- **Maintenance Workers** – Potential receptors under current or future land uses. Maintenance Workers may include adult military or civilian personnel assigned to groundskeeping or similar activities at the

site. This receptor potentially could be exposed to surface soil (0 to 1 foot bgs) by ingestion and dermal contact.

- Trespassers (Ages 7 to 16) – Potential receptor under future land uses. Older children and teenagers (civilians or family of military personnel living outside the site boundaries) trespassing on or near the site while exploring, playing, etc., will be evaluated. If the current paving material were removed from the site in the future, this receptor could potentially be exposed to surface soil (0 to 1 foot bgs) by ingestion and dermal contact.
- Construction Workers - Potential receptors under future land uses. Construction workers are assumed to be civilian personnel who may be involved in a short-term, one-time construction project. Excavation and ground-intrusive activities may occur on the site in the future. If these excavation projects were to occur, construction workers could potentially be exposed to surface and subsurface soil to an estimated depth of 10 feet bgs (conservative estimate based on available site information) by ingestion and dermal contact, and to groundwater (estimated depth to groundwater at the site ranges from 4 to 10 feet bgs) by dermal contact. Construction workers may also be exposed by inhaling dusts from soil or vapors emitted from soil or groundwater during excavation.
- Future Military Residents (Adults/Children) – Potential receptor under future land uses. Military residents are not potential receptors under current land use because they do not live on the site. They will be evaluated primarily for decision-making (risk management) purposes based on the assumption that the site could support military residential use in the future. Future military residents are assumed to be exposed to soil by ingestion, dermal contact and inhalation of fugitive dust and vapors for a representative enlistment time of 6 years. Exposure to groundwater will not be evaluated for this receptor because groundwater at Site 7 is not used as a potable water source under current conditions and is not anticipated to be used for this purpose under projected future land uses.
- Future Civilian Residents (Adults/Children) – Potential receptor under future land uses. Hypothetical future residents are not potential receptors under current land use but will be evaluated to aid in risk management decisions by providing an indication of potential risks if the facility were to close and be developed for residential use. Future onsite residents are assumed to be exposed to surface/subsurface soil by ingestion, dermal contact, and inhalation of fugitive dust and vapors. Exposure to groundwater will not be evaluated for this receptor because groundwater at Site 7 is not used as a potable water source under current conditions and is not anticipated to be used for this purpose under potential future land uses.

- Navy recruits were also considered as potential receptors at Site 7. However, exposure for the recruits was assumed to be negligible because of the physical characteristics of the site (i.e., a large portion of the site is paved), because of the limited time recruits spend at NTC Great Lakes (i.e., 12 weeks), and because the lack of idle time allocated to recruits during training. Therefore, risks to Navy recruits will not be evaluated in the risk assessment.

Table 2 summarizes the exposure routes that will be addressed quantitatively for each receptor at Site 7.

## **2.2 Central Tendency Exposure vs. Reasonable Maximum Exposure**

Traditionally, exposures evaluated in the human health risk assessment were based on the concept of a Reasonable Maximum Exposure (RME) only, which is defined as "the maximum exposure that is reasonably expected to occur at a site" (U.S. EPA, 1989). However, more recent risk assessment guidance (U.S. EPA, 1993a) indicates the need to address an average case or Central Tendency Exposure (CTE).

To provide a full characterization of potential exposure, both RME and CTE will be evaluated in the risk assessment for Site 7. The available guidance (U.S. EPA, 1993a) concerning the evaluation of CTE is limited. Therefore, professional judgment will be exercised when defining CTE conditions for a particular receptor at a site.

## **2.3 Exposure Point Concentrations (EPCs)**

The exposure concentration, calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time by a receptor and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL), which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (U.S. EPA, 1992). The 95 percent UCL will be used as the exposure concentration to assess RME and CTE risks (U.S. EPA, 1993a). For data sets with less than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration will be defined as the maximum concentration.

Conventional statistical methods (i.e., the Shapiro-Wilk W-Test) will be used to determine the distribution and UCL of a particular data set (Gilbert, 1987; U.S. EPA, 1992). Detailed sample calculations, as well as general methodology for the statistical evaluation, will be presented in the site-specific risk

assessments. Nondetected data points will be utilized; in general, one-half the sample-specific detection limit will be employed for these analytical results.

The following guidelines will be used to calculate the EPCs:

- If a data set contains less than 10 samples, the EPC for the RME and CTE cases will be defined as the maximum detected concentration.
- If a data set contains 10 or more samples, the 95 percent UCL on the arithmetic mean, based on the distribution of the data set, will be selected as the EPC for the RME and CTE cases. Conventional statistical methods (e.g., the Shapiro-Wilk W-Test, the t- and H-statistic based UCL calculation) will be used to determine the distribution and UCL. The "best fit" distribution (normal or lognormal) will be assumed if the data set distribution is undefined. However, the EPCs calculated assuming a lognormal distribution will be reviewed and re-calculated (if necessary), as recommended in U.S. EPA guidance (U.S. EPA, 1997b) so that the H-statistic based UCL is not an over-prediction of the EPC. If the calculated 95 percent UCL exceeds the maximum detected concentration, the maximum concentration will be used as the EPC. If enough data are available and a qualified statistician judges that Jackknife or Bootstrap procedures would present a more realistic estimation of risk, these techniques, which are described in the U.S. EPA (1997b) reference, may be used. Bootstrap and Jackknife procedures are nonparametric statistical techniques which can be used to reduce the bias of point estimates and construct approximate confidence intervals for parameters such as the population mean. These procedures require no assumptions regarding the statistical distribution (e.g., normal or lognormal) of the data and can be applied to a variety of situations, no matter how complicated. The Bootstrap and Jackknife procedures, which are based on resampling techniques, are conceptually simple but require considerable computing power and time.

## **2.4 Chemical Intake Estimation**

The methodologies and techniques used to estimate exposure via ingestion, dermal contact, or inhalation are presented in this section of the Work Plan. Intakes for the identified potential receptor groups will be calculated using U.S. EPA risk assessment guidance (U.S. EPA, 1989 and 2000a) and presented in the risk assessment spreadsheets which will be appended to the risk assessment as support documentation.

Noncarcinogenic intakes will be estimated using the concept of an average annual exposure. Carcinogenic intakes will be calculated as an incremental lifetime exposure, that will assume a life expectancy of 70 years. Equations used to calculate estimated intakes are provided below.

Values of the exposure parameters and assumptions regarding exposure for receptors and exposure pathways are presented in Table 3 through Table 10.

#### 2.4.1 Dermal Contact with Soil

Direct physical contact with soil may result in the dermal absorption of chemicals. Exposures associated with the dermal route are estimated in the following manner (U.S. EPA, 1989 and 2000a):

$$Intake_{si} = (C_{si})(SA)(AF)(ABS)(CF)(EF)(ED) / (BW)(AT)$$

where:

$Intake_{si}$	=	amount of chemical "i" absorbed during contact with soil (mg/kg/day)
$C_{si}$	=	concentration of chemical "i" in soil (mg/kg)
SA	=	skin surface area available for contact (cm <sup>2</sup> /day)
AF	=	skin adherence factor (mg/cm <sup>2</sup> )
ABS	=	absorption factor (dimensionless)
CF	=	conversion factor (1E-6 kg/mg)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, AT = ED x 365 days/yr;
		for carcinogens, AT = 70 yrs x 365 days/yr

Exposed surface areas of body available for dermal contact are determined for each receptor based on assumed human activities and clothing worn during exposure events. U.S. EPA guidance (U.S. EPA, 1997a and 2000a) are used to develop the default assumptions concerning the amount of skin surface area available for contact for a receptor. The skin surface areas that will be used in risk assessment calculations and the rationale for the selection of the surface areas are as follows:

- For adolescent trespassers, 25 percent of the total body surface area of an adolescent (aged 7 to 16) will be assumed to be available for contact with surface soil. The RME value (3,820 cm<sup>2</sup>) is derived from the 95th percentile surface area data and the CTE value (3,100 cm<sup>2</sup>) is derived from the 50th percentile data, as provided in Table 6-6 of the Exposure Factors Handbook (U.S. EPA, 1997a).

- Maintenance workers are assumed to be exposed on the head, hands and forearms assuming that they wear a short-sleeved shirt, long pants, and shoes. As recommended in RAGS Part E (U.S. EPA, 2000a), this skin surface area is assumed to be 3,300 cm<sup>2</sup> for the RME and CTE scenarios. This value represents the average of the 50<sup>th</sup> percentile areas of males and females more than 18 years old.
- For construction workers exposed to surface/subsurface soil and groundwater, the surface areas for the RME (5,800 cm<sup>2</sup>) and CTE (5,000 cm<sup>2</sup>) are the values recommended for soil contact by the U.S. EPA in the Exposure Factors Handbook (U.S. EPA, 1997a). These values represent 25 percent of the 50<sup>th</sup> and 95<sup>th</sup> percentile total body surface areas of an adult male.
- For future military and civilian adult residents assumed exposed to surface/subsurface soil, the exposed surface areas available for contact will be the values for the adult skin surface area for exposure to soil recommended in RAGS Part E (U.S. EPA, 2000a), 5,700 cm<sup>2</sup> for the RME and for the CTE. This skin area assumes that head, hands, forearms, and lower legs of the adult are available for contact. For child residents (military and civilian) assumed to be exposed to surface/subsurface soil, the exposed surface areas available for contact will be the values for child skin surface area for exposure to soil recommended in RAGS Part E (U.S. EPA, 2000a), 2,800 cm<sup>2</sup> for the RME and for the CTE. This skin area assumes that head, hands, forearms, lower legs, and feet of the child are available for contact.

Values of soil adherence factors and chemical-specific dermal absorption factors provided in RAGS Part E (U.S. EPA, 2000a) will be used to evaluate risks from exposure to soil. The following soil adherence factors will be used for the RME and CTE exposure scenarios:

- Maintenance workers – 0.2 mg/cm<sup>2</sup> for the RME and 0.02 mg/cm<sup>2</sup> for the CTE (Exhibit 3.5, U.S. EPA, 2000a).
- Construction workers – 0.3 mg/cm<sup>2</sup> for the RME and 0.1 mg/cm<sup>2</sup> for the CTE (Exhibit 3.3, U.S. EPA, 2000a).
- Trespassers – 0.3 mg/cm<sup>2</sup> for the RME and 0.04 mg/cm<sup>2</sup> for the CTE. This is based on the assumption of teens playing in moist conditions (Exhibit 3.3, U.S. EPA, 2000a).
- Future adult residents – 0.07 mg/cm<sup>2</sup> for the RME and 0.01 mg/cm<sup>2</sup> for the CTE (Exhibit 3.5, U.S. EPA, 2000a).
- Future child residents – 0.2 mg/cm<sup>2</sup> for the RME and 0.04 mg/cm<sup>2</sup> for the CTE (Exhibit 3.5, U.S. EPA, 2000a).

For the constituents identified as COPCs in soil, the following absorption factors will be used (U.S. EPA, 2000a):

- PCBs – 0.14
- PAHS – 0.13
- DDD, DDE, and DDT – 0.03
- Chlordane – 0.04
- Lindane – 0.04
- Arsenic – 0.03
- Cadmium – 0.001
- Semivolatile Organics – 0.1
- Other Inorganics and Volatile Organics – not evaluated for dermal contact with soil (U.S. EPA, 2000a)

#### 2.4.2 Incidental Ingestion of Soil

Incidental ingestion of soil by potential receptors is assumed to coincide with dermal exposure. Exposures associated with incidental ingestion are estimated in the following manner (U.S. EPA, 1989):

$$Intake_{si} = (C_{si})(IR_s)(FI)(EF)(ED)(CF) / (BW)(AT)$$

where:

$Intake_{si}$	=	intake of contaminant "i" from soil (mg/kg/day)
$C_{si}$	=	concentration of contaminant "i" in soil (mg/kg)
$IR_s$	=	ingestion rate (mg/day)
$FI$	=	fraction ingested from contaminated source (dimensionless)
$EF$	=	exposure frequency (days/yr)
$ED$	=	exposure duration (yr)
$CF$	=	conversion factor (1E-6 kg/mg)
$BW$	=	body weight (kg)
$AT$	=	averaging time (days); for noncarcinogens, $AT = ED \times 365$ days/yr; for carcinogens, $AT = 70$ yrs $\times$ 365 days/yr

The same exposure frequencies and durations used in the estimation of dermal intakes will be used to estimate exposure via incidental ingestion. A default value of 1.0 (U.S. EPA, 1989) will be used for the fraction of soil ingested from the contaminated source for the RME and CTE scenarios. For the RME scenario, the ingestion rate is set at 480 mg/day for the construction worker, 200 mg/day for the future child resident, and 100 mg/day for all other potential receptors (the maintenance worker, future adult resident, and adolescent trespasser) (U.S. EPA, 1991a). Ingestion rates for the CTE are assumed to be one-half of the RME values.

### 2.4.3 Dermal Contact with Groundwater

Dermal contact with groundwater will be evaluated by methods and equations provided in RAGS Part E (U.S. EPA, 2000a). Direct contact with groundwater will be limited to exposure that would occur during excavation and construction activities. In this scenario, construction workers are assumed to be exposed to groundwater by dermal contact for short periods of time.

The following equation will be used to assess exposures resulting from dermal contact with water (U.S. EPA, 2000a):

$$DAD_{wi} = (DA_{event})(EV)(ED)(EF)(A) / (BW)(AT)$$

where:

$DAD_{wi}$	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
$DA_{event}$	=	absorbed dose per event (mg/cm <sup>2</sup> -event)
EV	=	event frequency (events/day)
ED	=	exposure duration (yr)
EF	=	exposure frequency (days/yr)
A	=	skin surface area available for contact (cm <sup>2</sup> )
BW	=	body weight (kg)
AT	=	averaging time (days); for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yrs x 365 days/yr

The exposed surface area of construction workers is based on assumed activities and on the assumptions outlined for dermal contact with soil. Current guidance (U.S. EPA, 1997a and 2000a) was used to develop the following default assumptions concerning the amount of skin surface area available for contact for a receptor:



- For construction workers assumed exposed to groundwater, the surface areas for the RME (5,800 cm<sup>2</sup>) and CTE (5,000 cm<sup>2</sup>) are the values recommended for soil contact by the U.S. EPA in the Exposure Factors Handbook (U.S. EPA, 1997a). These values represent 25 percent of the 50<sup>th</sup> and 95<sup>th</sup> percentile total body surface areas of an adult male.

The absorbed dose per event (DA<sub>event</sub>) will be estimated using a nonsteady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{\text{event}} < t^*, \text{ then: } DA_{\text{event}} = (2FA)(K_p)(C_{\text{gw}})(CF) \left( \sqrt{\frac{6 \pi t_{\text{event}}}{\pi}} \right)$$

$$\text{If } t_{\text{event}} > t^*, \text{ then: } DA_{\text{event}} = (FA)(K_p)(C_{\text{gw}})(CF) \left( \frac{t_{\text{event}}}{1+B} + 2T \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right)$$

where:

$t_{\text{event}}$	=	duration of event (hr/event)
$t^*$	=	time it takes to reach steady-state conditions (hr)
FA	=	fraction absorbed (dimensionless)
$K_p$	=	permeability coefficient from groundwater through skin (cm/hr)
$C_{\text{gw}}$	=	concentration of chemical "i" in groundwater (mg/L)
$T$	=	lag time (hr)
$\pi$	=	constant (dimensionless; equal to 3.1416)
CF	=	conversion factor (1x10 <sup>-3</sup> L/cm <sup>3</sup> )
B	=	partitioning constant derived by Bunge Model (dimensionless)

Excavation/construction workers will be assumed to be exposed to groundwater 150 days per year (2.0 hours/day for the CTE and 4.0 hours/day for the RME), based on professional judgment. The exposure duration of 150 days a year is based on the assumption that the ground in the Great Lakes region is frozen 22 weeks a year and that excavation/construction does not occur during this time.

Values for the chemical-specific parameters ( $t^*$ ,  $K_p$ ,  $T$ , and  $B$ ) will be obtained from the current dermal guidance (U.S. EPA, 2000a). If no published values are available for a particular compound, they will be calculated using equations provided in the cited guidance.

The following steady-state equation will be used to estimate  $DA_{event}$  for inorganics:

$$DA_{event} = (K_p) (C_{gw}) (t_{event})$$

The recommended default value of  $1 \times 10^{-3}$  will be used for the dermal permeability of inorganic constituents, unless a chemical-specific value is provided in the U.S. EPA guidance. For most metals, dermal absorption is not a significant pathway because penetration through the skin is minimal.

#### 2.4.4 Inhalation of Air Containing Fugitive Dust/Volatiles Emitted from Soil

As stated previously, the inhalation pathway will be quantitatively evaluated only if it is determined by a comparison with U.S. EPA Generic Inhalation SSLs that a quantitative evaluation is necessary. If this pathway is quantitatively evaluated, risks will be calculated only for those chemicals that exceed their respective SSLs. If it is determined that a quantitative evaluation is not required, the potential risks associated with the inhalation pathway will be regarded as minimal and no further evaluation will be performed.

The amount of chemical a receptor takes in as a result of respiration is determined using the concentration of the contaminant in air. Intakes of both particulates and vapors from soil will be calculated using the same equation, as follows (U.S. EPA, 1991b and 1996a):

$$Intake_{ai} = [C_{si} \times IR_a \times ET \times EF \times ED \times (1/PEF + 1/VF)] / (BW \times AT)$$

where: $Intake_{ai}$ =	intake of chemical "i" from air via inhalation (mg/kg/day)
$C_{si}$	= concentration of chemical "i" in soil (mg/kg)
$IR_a$	= inhalation rate ( $m^3/hr$ or day)
$ET$	= exposure time (hours/day)
$EF$	= exposure frequency (days/yr)
$ED$	= exposure duration (yr)
$PEF$	= Particulate Emission Factor ( $m^3/kg$ )
$VF$	= Volatilization Factor (chemical-specific) ( $m^3/kg$ )
$BW$	= body weight (kg)

AT = averaging time (days);  
 for noncarcinogens, AT = ED x 365 days/yr;  
 for carcinogens, AT = 70 yr x 365 days/yr

The concentration of a chemical in air will be developed using the methodology provided in the U.S. EPA's Soil Screening Guidance (U.S. EPA, 1996a), measured soil concentrations, and additional site-specific information, such as source area and wind speed. The following inhalation rates will be used to calculate the inhalation intakes: 2.5 m<sup>3</sup>/hour for construction workers (U.S. EPA, 1997a, Table 5-23), 20 m<sup>3</sup>/day for adult residents (U.S. EPA, 1989), and 10 m<sup>3</sup>/day for child residents six years of age (U.S. EPA, 1997a, Table 5-23).

#### 2.4.5 Inhalation of Air Containing Volatiles Emitted from Groundwater

In the event that volatile organic chemicals (VOCs) are detected in groundwater, construction workers may be exposed to COPCs that have volatilized from groundwater when excavation exposes the water table. If quantitative evaluation of this pathway becomes necessary, ambient air concentrations resulting from the volatilization of COPCs from groundwater to outdoor air will be calculated by using the following equation from American Society for Testing and Materials *Standard Guide for Risk-Based Corrective Action* (ASTM, 1997). The air concentration is calculated from:

$$C_{air} = VF_{gw,amb} \cdot C_{gw} \cdot 10^3 \frac{L}{m^3}$$

where:  $C_{air}$  = chemical concentration in indoor air, mg/m<sup>3</sup>  
 $VF_{gw,amb}$  = volatilization factor from groundwater to indoor air, cm<sup>3</sup>-water/cm<sup>3</sup>-air  
 $C_{gw}$  = chemical concentration in groundwater, mg/L

The volatilization factor,  $VF_{gw,amb}$ , is calculated from:

$$VF_{gw} = \frac{1}{\left[ \frac{DF_{amb} \cdot L_{GW}}{D_{ws}^{eff}} \right] \cdot \frac{1}{H'}} \cdot 10^3 \cdot \frac{L}{m^3}$$

and

$$DF_{amb} = \frac{U_{air} \cdot W \cdot d_{air}}{A}$$

where: $VF_{gw}$	=	volatilization factor for groundwater, (L/m <sup>3</sup> )
$H'$	=	Henry's law constant, chemical specific, (cm <sup>3</sup> -H <sub>2</sub> O)/(cm <sup>3</sup> -air)
$L_{GW}$	=	depth to groundwater, (cm)
	=	$h_v + h_{cap}$
$h_v$	=	thickness of vadose zone, (cm)
$h_{cap}$	=	thickness of capillary fringe; (cm)
$D_{ws}^{eff}$	=	effective diffusion coefficient between groundwater and surface soil, chemical specific, (cm <sup>2</sup> /sec)
$DF_{amb}$	=	dispersion factor for outdoor air, (cm/sec)
$U_{air}$	=	wind speed above ground surface in mixing zone, (cm/sec)
$d_{air}$	=	ambient air mixing zone, (cm)
$W$	=	width of source parallel to groundwater flow direction, (cm)
$A$	=	source-zone area, (cm <sup>2</sup> )

Because exposure to constituents that have volatilized from groundwater is a result of direct exposure, the depth to groundwater is simply ( $L_{gw}$ ) defined as the thickness of the capillary fringe ( $h_{cap}$ ).

The effective diffusion coefficient between groundwater and surface soil,  $D_{ws}^{eff}$  is calculated from:

$$D_{ws}^{eff} = \frac{L_{gw}}{(h_v / D_s^{eff}) + (h_{cap} / D_{cap}^{eff})}$$

Where: $D_{cap}^{eff}$	=	effective diffusion through capillary fringe, chemical specific, cm <sup>2</sup> /sec
$D_s^{eff}$	=	effective diffusion in soil based on vapor-phase concentration, chemical specific, cm <sup>2</sup> /sec

It will be assumed that excavation would occur to the water table, therefore the thickness of the vadose zone was set equal to 0 and the thickness of the capillary fringe was set equal to 0.1 cm. Because  $h_v$  is equal to zero, this equation reduces to show that the effective diffusion between groundwater and surface soil ( $D_{ws}^{eff}$ ) is equal to the effective diffusion through the capillary fringe ( $D_{cap}^{eff}$ ).

The effective diffusion through the capillary fringe,  $D_{cap}^{eff}$ , is calculated from:

$$D_{cap}^{eff} = D^{air} \cdot \frac{\theta_{acap}^{3.33}}{\theta_T^2} + D^{wat} \cdot \frac{1}{H} \cdot \frac{\theta_{wcap}^{3.33}}{\theta_T^2}$$

where:  $D^{air}$  = diffusion coefficient in air, chemical specific,  $cm^2/sec$   
 $D^{wat}$  = diffusion coefficient in water, chemical specific,  $cm^2/sec$   
 $\theta_{acap}$  = volumetric air content in capillary fringe soils,  $0.038 \text{ cm}^3\text{-air}/\text{cm}^3\text{-soil}$   
 $\theta_{wcap}$  = volumetric water content in capillary fringe soils,  $0.342 \text{ cm}^3\text{-H}_2\text{O}/\text{cm}^3\text{-soil}$   
 $\theta_T$  = total soil porosity,  $0.38 \text{ cm}^3/\text{cm}^3\text{-soil}$

Input assumptions for the volatilization from groundwater to outdoor air model will be presented in an appendix to the risk assessment. Site specific values will be used whenever possible. Model default values will be used when they are believed to be representative of site conditions. Chemical properties will be obtained from the Soil Screening Guidance: User's Guide (U.S. EPA, 1996a), the Hazardous Substance Data Base (HSDB) (<http://toxnet.nlm.nih.gov>), or the Risk Assessment Information System (RAIS), Office of Environment (<http://risk.lsd.ornl.gov>).

Intakes of vapors from groundwater will be calculated using the air concentration estimated by the above model and the following equation (U.S. EPA, 1989):

$$Intake_{ai} = (C_{ai})(IR_a)(ET)(EF)(ED) / (BW)(AT)$$

where:  $Intake_{ai}$  = intake of chemical "i" from air via inhalation (mg/kg/day)  
 $C_{ai}$  = concentration of chemical "i" in air ( $mg/m^3$ ) (calculated)  
 $IR_a$  = inhalation rate ( $m^3/hr$ )  
 $ET$  = exposure time (hours/day)  
 $EF$  = exposure frequency (days/yr)  
 $ED$  = exposure duration (yr)  
 $BW$  = body weight (kg)  
 $AT$  = averaging time (days);  
for noncarcinogens,  $AT = ED \times 365 \text{ days/yr}$ ;  
for carcinogens,  $AT = 70 \text{ yrs} \times 365 \text{ days/yr}$

An inhalation rate of 2.5 m<sup>3</sup>/hour (U.S. EPA, 1997a, Table 5-23) will be used to calculate the inhalation intake for construction workers.

## **2.5      Exposure to Lead**

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters. Exposure to lead will be assessed using the latest version of the U.S. EPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (U.S. EPA, 1994b). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure.

Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood lead levels. The threshold for toxic effects from this chemical is believed to be in the range of 10 µg/dL to 15 µg/dL. Blood lead levels greater than 10 µg/dL are considered to be a "concern."

The IEUBK Model for lead will be used to address exposure to lead in children if detected groundwater concentrations exceed the 15 µg/L Federal Action Level promulgated under the Safe Drinking Water Act or if detected soil concentrations exceed the OSWER soil screening level of 400 mg/kg for residential land use (US EPA, 1994a). Average chemical concentrations, as well as default values for some input parameters, will be employed. Estimated blood lead levels and probability density histograms will be presented as support documentation for this analysis and appended to the risk assessment.

Adult exposure to lead in soil will be quantified by the model provided by the U.S. EPA's Technical Review Workgroup for Lead (U.S. EPA, 1996b). In this model, adult exposure to lead in soil is addressed by an evaluation of the relationship between the site soil lead concentration and the blood lead concentration in the developing fetuses of adult women. The adult lead model will generate a spreadsheet for each exposure scenario evaluated (i.e., workers and adult residents). The spreadsheets will calculate a range of 95<sup>th</sup> percentile fetal blood lead concentrations from central estimates of blood lead concentrations in pregnant adult women. The spreadsheets also calculate 95<sup>th</sup> percentile blood lead concentrations in fetuses born to women exposed to lead in soil.

No models are currently available to evaluate the periodic exposure of adolescent trespassers to lead. Therefore, the results of the IEUBK Model for children will be used to qualitatively assess exposure of this

receptor. Essentially, the qualitative discussion will note that potential adverse effects from exposure to lead are expected to be of a lesser magnitude for adolescent trespassers than for children.

### **3.0 TOXICITY ASSESSMENT**

The objective of the toxicity assessment is to identify the potential health hazards and adverse effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects will be defined for the identified COPCs. Quantitative toxicity values determined during this component of the risk assessment will be integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The toxicity value used to evaluate noncarcinogenic health effects is the Reference Dose (RfD). Carcinogenic effects are quantified using the Cancer Slope Factor (CSF).

#### **3.1 Toxicity Criteria**

Oral and inhalation RfDs and CSFs to be used in the site-specific risk assessment for Site 7 will be obtained from the following primary literature sources:

- Integrated Risk Information System (IRIS) (U.S. EPA, available online)
- Annual Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1997c)
- NCEA Superfund Health Risk Technical Support Center

Although RfDs and CSFs can be found in several toxicological sources, U.S. EPA's IRIS online database is the preferred source for toxicity values. This database is continuously updated and values presented have been verified by U.S. EPA RfD and Carcinogenic Risk Assessment Verification Endeavor (CRAVE) work groups. The U.S. EPA Region 9 PRG tables and Region 3 Risk-Based Concentration (RBC) tables will also be used as a source of toxicity criteria.

#### **3.2 Toxicity Criteria for Dermal Exposure**

RfDs and CSFs found in literature may be expressed as administered doses; therefore, these values are considered to be inappropriate for estimating the risks associated with dermal routes of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made. Because this information is not always readily available, oral dose-response parameters will be adjusted to an absorbed dose using chemical-

specific absorption efficiencies published in available guidance (U.S. EPA, 2000a) and the following equations:

$$RfD_{\text{dermal}} = (RfD_{\text{oral}})(ABS_{\text{GI}})$$

$$CSF_{\text{dermal}} = (CSF_{\text{oral}}) / (ABS_{\text{GI}})$$

where:

$ABS_{\text{GI}}$  = absorption efficiency in the gastrointestinal tract

Absorption efficiencies used in the risk assessments will reflect the U.S. EPA's current dermal assessment guidance (U.S. EPA, 2000a).

### **3.3 Toxicity Criteria for Carcinogenic Effects of Polynuclear Aromatic Hydrocarbons (PAHs)**

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to PAHs. The most extensively studied PAH is benzo(a)pyrene, classified by the U.S. EPA as a known human carcinogen. Although CSFs are available for benzo(a)pyrene, insufficient data are available to calculate CSFs for other carcinogenic PAHs. Toxic effects for these chemicals will be evaluated using the concept of estimated orders of potential potency, as presented in U.S. EPA guidance (U.S. EPA, 1993b). These parameters are based on the carcinogenicity of benzo(a)pyrene and are available for select carcinogenic PAHs. The equivalent oral and inhalation CSF for these chemicals is derived by multiplying the CSF for benzo(a)pyrene by the order of potential potency.

### **3.4 Toxicity Criteria for Chromium**

Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, of which the latter is considered to be more toxic. The screening of chromium will be conducted assuming that 100 percent of the reported total chromium is hexavalent. Should chromium, assumed to be all hexavalent, prove to be a significant contributor to risk, further investigation regarding the presence and valence state of chromium may be necessary. The uncertainty associated with the assumption that all chromium is hexavalent chromium will be discussed in the uncertainty section of the risk assessment.



### **3.5      Toxicity Profiles**

Toxicological profiles for each COPC will be presented in an appendix to the risk assessment. These brief profiles will present a summary of the currently available literature on the carcinogenic and noncarcinogenic health effects associated with human exposure to the COPCs.

## **4.0      RISK CHARACTERIZATION**

Potential risks (noncarcinogenic and carcinogenic) for human receptors resulting from the exposures outlined in the exposure assessment are quantitatively determined during the risk characterization component of the Baseline Human Health Risk Assessment.

A summary and interpretive discussion of the quantitative risk estimates will be provided in the text of the risk assessment. During the interpretive risk discussion, COPCs that contribute significantly to elevated risks will be identified as "risk drivers" or Chemicals of Concern (COCs). The numeric estimates of risk will be contained in the risk assessment spreadsheets that will be appended to the risk assessment as support documentation.

### **4.1      Quantitative Analysis**

Quantitative estimates of risk will be calculated according to risk assessment methods outlined in U.S. EPA guidance (U.S. EPA, 1989). Lifetime cancer risks will be expressed in the form of dimensionless probabilities, referred to as incremental cancer risks (ICRs), based on CSFs. Noncarcinogenic risk estimates will be presented in the form of Hazard Quotients (HQs) that are determined through a comparison of intakes with published RfDs.

ICR estimates are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ICR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

If the above equation results in an ICR greater than 0.01, the following equation (U.S. EPA, 1989) will be used:

$$\text{ICR} = 1 - [\exp (-\text{Estimated Exposure Intake})(\text{CSF})]$$

An ICR of  $1 \times 10^{-6}$  indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

As mentioned previously, noncarcinogenic risks will be assessed using the concept of HQs and Hazard Indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

$$HQ = (\text{Estimated Exposure Intake}) / (\text{RfD})$$

An HI will be generated by summing the individual HQs for the COPCs. The HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

#### **4.2      Comparison of Quantitative Risk Estimates to Benchmarks**

Quantitative risk estimates will be compared to typical benchmarks to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site. Calculated ICRs will be interpreted using the U.S. EPA's "target range" ( $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ ), while HIs will be evaluated using a value of 1.0.

The U.S. EPA has defined the range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  as the ICR "target range" for most hazardous waste facilities addressed under CERCLA and RCRA. Individual or cumulative ICRs greater than  $1 \times 10^{-4}$  will typically not be considered as protective of human health, while ICRs less than  $1 \times 10^{-6}$  will typically be regarded as protective. Risk management decisions are necessary when the ICR is within the  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  cancer risk range. Risks greater than  $1 \times 10^{-6}$  will be noted and discussed in the risk assessment.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, a segregation of target organs effects associated with exposure to COPCs will be performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1.0, but have no anticipated adverse health effects if the COPCs do not affect the same target organ or exhibit the same critical effect.

#### **4.3      Qualitative Analysis**

A qualitative evaluation of risk will be made for several exposure situations.

- The soil inhalation pathway will be initially evaluated by a comparison of maximum site soil concentrations to U.S. EPA Generic SSLs for transfers from soil to air. If the maximum site concentration exceeds the SSL for a chemical, a quantitative analysis of this exposure pathway will be performed.
- The potential for the migration of soil contaminants to groundwater will be assessed by a comparison of maximum and average soil concentrations to IEPA and U.S. EPA Region 3 SSLs for transfers from soils to groundwater. SSLs based on dilution and attenuation factors (DAFs) of 1 and 20, respectively, will be used in the evaluation. The comparisons will be presented in tables and results of the analysis will be discussed in the risk assessment.

## **5.0 UNCERTAINTY ANALYSIS**

The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the Baseline Human Health Risk Assessment. Uncertainties related to each component of the assessment (i.e., data evaluation, exposure assessment, toxicity assessment, and risk characterization) will be presented. In addition, the effect of a particular uncertainty on the outcome of the assessment (i.e., risk estimates) will also be discussed, where possible. The following subsections present an overview of uncertainties that may be addressed in the risk assessment uncertainty section.

### **5.1 Uncertainty in Data Evaluation**

This section may discuss uncertainties in the risk assessment associated with the analytical data and data quality. This may also involve a discussion of uncertainty in the COPC selection process, the inclusion or exclusion of COPCs in the risk assessment on the basis of background concentrations, the uncertainty in COPC screening levels, and the omission of constituents for which health criteria are not available. The discussion will be based, in part, on the evaluation in the "Data Useability Worksheet" as suggested RAGS Part D (EPA, 1998).

### **5.2 Uncertainty in the Exposure Assessment**

This section will include a discussion of the following: assumptions related to current and future land use; the uncertainty in exposure point concentrations, for example, the use of maximum concentrations to estimate risks; uncertainty in the selection of potential receptors and exposure scenarios; and uncertainty in the selection of exposure parameters (RME vs. CTE). If predictive models are used in the risk estimation, the uncertainty associated with the model and modeling parameters will be evaluated.

### **5.3      Uncertainty in the Toxicity Assessment**

The uncertainties inherent in RfDs and CSFs and use of available criteria will be discussed. A discussion of the uncertainty in hazard assessment that deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans, will be provided. This section will also discuss uncertainty in the dose-response evaluations for the COPCs that relates to the determination of a CSF for the carcinogenic assessment and derivation of an RfD or Reference Concentration (RfC) for the noncarcinogenic assessment. In addition, a discussion of the uncertainty in the toxicity of specific constituents, such as PAHs, arsenic, chromium, aluminum, iron, and copper, will be presented, if applicable.

### **5.4      Uncertainty in the Risk Characterization**

This section will discuss the uncertainty in risk characterization that results primarily from assumptions made regarding additivity/synergism of effects from exposure to multiple COPCs affecting different target organs across various exposure routes. The risk assessment will discuss the uncertainty inherent in summing risks for several substances across different exposure pathways. It should be noted that probabilistic risk assessment techniques may also be used to further define the uncertainty attached to the risk characterization results. However, the exposure assumptions (e.g., probability distributions) used to prepare the probabilistic risk assessment will be reviewed with the regulatory reviewers before they are incorporated into the uncertainty section of the baseline risk assessment.

This page intentionally left blank.

SITE 7 - TABLE 1

**OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe:

Medium:

Exposure Medium:

Exposure Point:

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)

1 Minimum/maximum detected concentration.

2 N/A - Refer to supporting information for background discussion.

Background values derived from statistical analysis. Follow Regional guidance and provide supporting information.

3 Provide reference for screening toxicity value.

4 Rationale Codes: Selection Reason:

Infrequent Detection but Associated Historically (HIST).

Frequent Detection (FD)

Toxicity Information Available (TX0)

Above Screening Levels (ASL)

Deletion Reason:

Infrequent Detection (IFD)

Background Levels (BKG)

No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

Definitions: N/A = Not Applicable

SQL = Sample Quantitation Limit

COPC = Chemical of Potential Concern

ARAC/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

J = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

**SITE 7 - TABLE 2**

**EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

<b>Receptors</b>	<b>Exposure Routes</b>
Maintenance Workers (current/future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact (surface)</li> <li>• Soil Ingestion (surface)</li> </ul>
Adolescent Trespassers (7 to 16 Years) (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact (surface)</li> <li>• Soil Ingestion (surface)</li> </ul>
Construction Workers (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact (surface/subsurface)</li> <li>• Soil Ingestion (surface/subsurface)</li> <li>• Inhalation of Air/Dust/Emissions (surface/subsurface)</li> <li>• Ground Water Dermal Contact (during excavation)</li> <li>• Ground Water Inhalation of Volatile Organics (during excavation)</li> </ul>
On-Base Military Residents (Adult/Children) (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact (surface/subsurface)</li> <li>• Soil Ingestion (surface/subsurface)</li> <li>• Inhalation of Air/Dust/Emissions (surface/subsurface)</li> </ul>
On-site Civilian Residents (Adult/Children) (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact (surface/subsurface)</li> <li>• Soil Ingestion (surface/subsurface)</li> <li>• Inhalation of Air/Dust/Emissions (surface/subsurface)</li> </ul>

SITE 7 - TABLE 3

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR EXPOSURE OF  
CONSTRUCTION WORKERS TO SURFACE / SUBSURFACE SOIL  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface / Subsurface Soil  
Receptor Population: Construction Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993a	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ BW x AT
	IRs	Ingestion Rate of Soil	(mg/day)	480	U.S. EPA 1993a	240	U.S. EPA 1993a	
	EF	Exposure Frequency	(days/year)	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	365	U.S. EPA 1989	365	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ BW x AT
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.3	U.S. EPA 2000	0.1	U.S. EPA 2000a	
	SA	Skin Surface Area	(cm <sup>2</sup> )	5,800	U.S. EPA 1997	5,000	U.S. EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000a	chemical-specific	U.S. EPA 2000a	
	EF	Exposure Frequency	(days/year)	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	
	ED	Exposure Duration	(years)	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	365	U.S. EPA 1989	365	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002

U.S. EPA, 1993a: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997a: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

U.S. EPA, 2000a: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.



SITE 7 - TABLE 4

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR EXPOSURE OF  
MAINTENANCE WORKERS TO SOIL  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Current/Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface Soil  
Receptor Population: Maintenance Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993a	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ BW x AT
	IRs	Ingestion Rate of Soil	(mg/day)	100	U.S. EPA 1993a	50	U.S. EPA 1993a	
	EF	Exposure Frequency	(days/year)	24	Professional Judgement (2 days per month)	12	Professional Judgement (1/2 the RME )	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	25	U.S. EPA 1993a	9	U.S. EPA 1993a	
	CF	Conversion Factor	(kg/mg)	1.0E-06	U.S. EPA 1989	1.0E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	U.S. EPA 1989	3,285	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993a	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ BW x AT
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.2	U.S. EPA 2000a	0.02	U.S. EPA 2000a	
	SA	Skin Surface Area	(cm <sup>2</sup> )	3,300	U.S. EPA 2000a	3,300	U.S. EPA 2000a	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000a	chemical-specific	U.S. EPA 2000a	
	EF	Exposure Frequency	(days/year)	24	Professional Judgement (2 days per month)	12	Professional Judgement (1/2 the RME )	
	ED	Exposure Duration	(years)	25	U.S. EPA 1993a	9	U.S. EPA 1993a	
	CF	Conversion Factor	(kg/mg)	1.0E-06	U.S. EPA 1989	1.0E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	9,125	U.S. EPA 1989	3,285	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993a: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 2000a: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 7 - TABLE 5

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF ADOLESCENT TRESPASSERS TO SOIL  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface Soil  
Receptor Population: Trespassers  
Receptor Age: Adolescent (7 to 16 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993a	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ $BW \times AT$
	IRs	Ingestion Rate of Soil	(mg/day)	100	U.S. EPA 1993a	50	U.S. EPA 1993a	
	EF	Exposure Frequency	(days/year)	26	Professional Judgement (1 day per week in warm weather months)	13	Professional Judgement (1/2 the RME )	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	10	Adolescent, Age 7 - 16	10	Adolescent, Age 6 - 16	
	CF	Conversion Factor	(kg/mg)	1.0E-06	U.S. EPA 1989	1.0E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	42	U.S. EPA 1997a	42	U.S. EPA 1997	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	U.S. EPA 1989	3,650	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993a	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ $BW \times AT$
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.3	U.S. EPA 2000a	0.04	U.S. EPA 2000a	
	SA	Skin Surface Area	(cm <sup>2</sup> )	3,280	U.S. EPA 1997a	3,100	U.S. EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000a	chemical-specific	U.S. EPA 2000a	
	EF	Exposure Frequency	(days/year)	26	Professional Judgement (1 day per week in warm weather months)	13	Professional Judgement (1/2 the RME )	
	ED	Exposure Duration	(years)	10	Adolescent, Age 7 - 16	10	Adolescent, Age 6 - 16	
	CF	Conversion Factor	(kg/mg)	1.0E-06	U.S. EPA 1989	1.0E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	42	U.S. EPA 1997a	42	U.S. EPA 1997a	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	U.S. EPA 1989	3,650	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. U.S. EPA/540/1-89/002.

U.S. EPA, 1993a: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997a: Exposure Factors Handbook, U.S. EPA/600/P-95/002Fa/, Office of Research and Development, August.

U.S. EPA, 2000a: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 7 - TABLE 6

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF FUTURE CIVILIAN ADULT RESIDENTS TO SURFACE / SUBSURFACE SOIL  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface and Subsurface Soil  
Receptor Population: Civilian Resident  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ BW x AT
	IRs	Ingestion Rate of Soil	(mg/day)	100	U.S. EPA 1993	50	U.S. EPA 1993	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	24	U.S. EPA 1993	7	U.S. EPA 1993	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	U.S. EPA 1989	2,555	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ BW x AT
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.07	U.S. EPA 2000	0.01	U.S. EPA 2000	
	SA	Skin Surface Area	(cm <sup>2</sup> )	5,700	U.S. EPA 2000	5,700	U.S. EPA 2000	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000	chemical-specific	U.S. EPA 2000	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	ED	Exposure Duration	(years)	24	U.S. EPA 1993	7	U.S. EPA 1993	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	U.S. EPA 1989	2,555	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. U.S. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

**SITE 7 - TABLE 7**

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR**  
**EXPOSURE OF FUTURE CIVILIAN CHILD RESIDENTS TO SURFACE / SUBSURFACE SOIL**  
**SITE 7 - FORMER SILK SCREENING SHOP**  
**NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface and Subsurface Soil  
Receptor Population: Civilian Resident  
Receptor Age: Child (0-6 Years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $\frac{Cs \times IRs \times CF \times FI \times EF \times ED}{BW \times AT}$
	IRs	Ingestion Rate of Soil	(mg/day)	200	U.S. EPA 1993	100	U.S. EPA 1993	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	6	U.S. EPA 1993	2	U.S. EPA 1993	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	15	U.S. EPA 1989	15	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
Dermal	AT-N	Averaging Time (Noncancer)	(days)	2,190	U.S. EPA 1989	730	U.S. EPA 1989	Chronic Daily Intake (CDI) (mg/kg-day) = $\frac{Cs \times SA \times CF \times ABS \times AF \times EF \times ED}{BW \times AT}$
	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.2	U.S. EPA 2000	0.04	U.S. EPA 2000	
	SA	Skin Surface Area	(cm <sup>2</sup> )	2,800	U.S. EPA 2000	2,800	U.S. EPA 2000	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000	chemical-specific	U.S. EPA 2000	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	ED	Exposure Duration	(years)	6	U.S. EPA 1993	2	U.S. EPA 1993	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	15	U.S. EPA 1989	15	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	U.S. EPA 1989	730	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 7 - TABLE 8

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF FUTURE MILITARY ADULT RESIDENTS TO SURFACE / SUBSURFACE SOIL  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface and Subsurface Soil  
Receptor Population: Military Resident  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ BW x AT
	IRs	Ingestion Rate of Soil	(mg/day)	100	U.S. EPA 1993	50	U.S. EPA 1993	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	6	Typical Enlistment Time	6	Typical Enlistment Time	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	U.S. EPA 1989	2,190	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ BW x AT
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.07	U.S. EPA 2000	0.01	U.S. EPA 2000	
	SA	Skin Surface Area	(cm <sup>2</sup> )	5,700	U.S. EPA 2000	5,700	U.S. EPA 2000	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000	chemical-specific	U.S. EPA 2000	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	ED	Exposure Duration	(years)	6	Typical Enlistment Time	6	Typical Enlistment Time	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	U.S. EPA 1989	2,190	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. U.S. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

## SITE 7 - TABLE 9

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF FUTURE MILITARY CHILD RESIDENTS TO SURFACE / SUBSURFACE SOIL  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface and Subsurface Soil  
Receptor Population: Military Resident  
Receptor Age: Child (0-6 Years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ $BW \times AT$
	IRs	Ingestion Rate of Soil	(mg/day)	200	U.S. EPA 1993	100	U.S. EPA 1993	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	6	Typical Enlistment Time	2	U.S. EPA 1993	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	15	U.S. EPA 1989	15	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
Dermal	AT-N	Averaging Time (Noncancer)	(days)	2,190	U.S. EPA 1989	730	U.S. EPA 1989	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ $BW \times AT$
	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.2	U.S. EPA 2000	0.04	U.S. EPA 2000	
	SA	Skin Surface Area	(cm <sup>2</sup> )	2,800	U.S. EPA 2000	2,800	U.S. EPA 2000	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000	chemical-specific	U.S. EPA 2000	
	EF	Exposure Frequency	(days/year)	350	U.S. EPA 1993	234	U.S. EPA 1993	
	ED	Exposure Duration	(years)	6	Typical Enlistment Time	2	U.S. EPA 1993	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	15	U.S. EPA 1989	15	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	2,190	U.S. EPA 1989	730	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. U.S. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 7 - TABLE 10

VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF CONSTRUCTION WORKERS TO GROUNDWATER  
SITE 7 - FORMER SILK SCREENING SHOP  
NTC GREAT LAKES, ILLINOIS

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Groundwater  
Exposure Point: Surficial Aquifer  
Receptor Population: Construction Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Dermal	Csw	Chemical Concentration in Surface Water	mg/L	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	$\text{Dermally Absorbed Dose} = \frac{\text{DAevent} \times \text{EV} \times \text{EF} \times \text{ED} \times \text{A}}{\text{BW} \times \text{AT}}$ $\text{DAevent} = \text{Constants} \times \text{Kp} \times \text{Cw} \times \text{tevent}$
	A	Skin Surface Area Available for Contact	cm <sup>2</sup>	5,800	U.S. EPA 1997	5,000	U.S. EPA 1997	
	DAevent	Absorbed Dose per Event	mg/cm <sup>2</sup> -event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	EF	Exposure Frequency	days/year	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	
	tevent	Duration of Event	hour/event	4	Professional judgement	2	Professional Judgement	
	t*	Time to reach steady state	hour/event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	T	Lag Time	hour/event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	B	Bunge Model Constant	dimensionless	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	BW	Body Weight	kg	70	U.S. EPA, 1989	70	U.S. EPA, 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, 1989	25,550	U.S. EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	365	U.S. EPA, 1989	365	U.S. EPA, 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

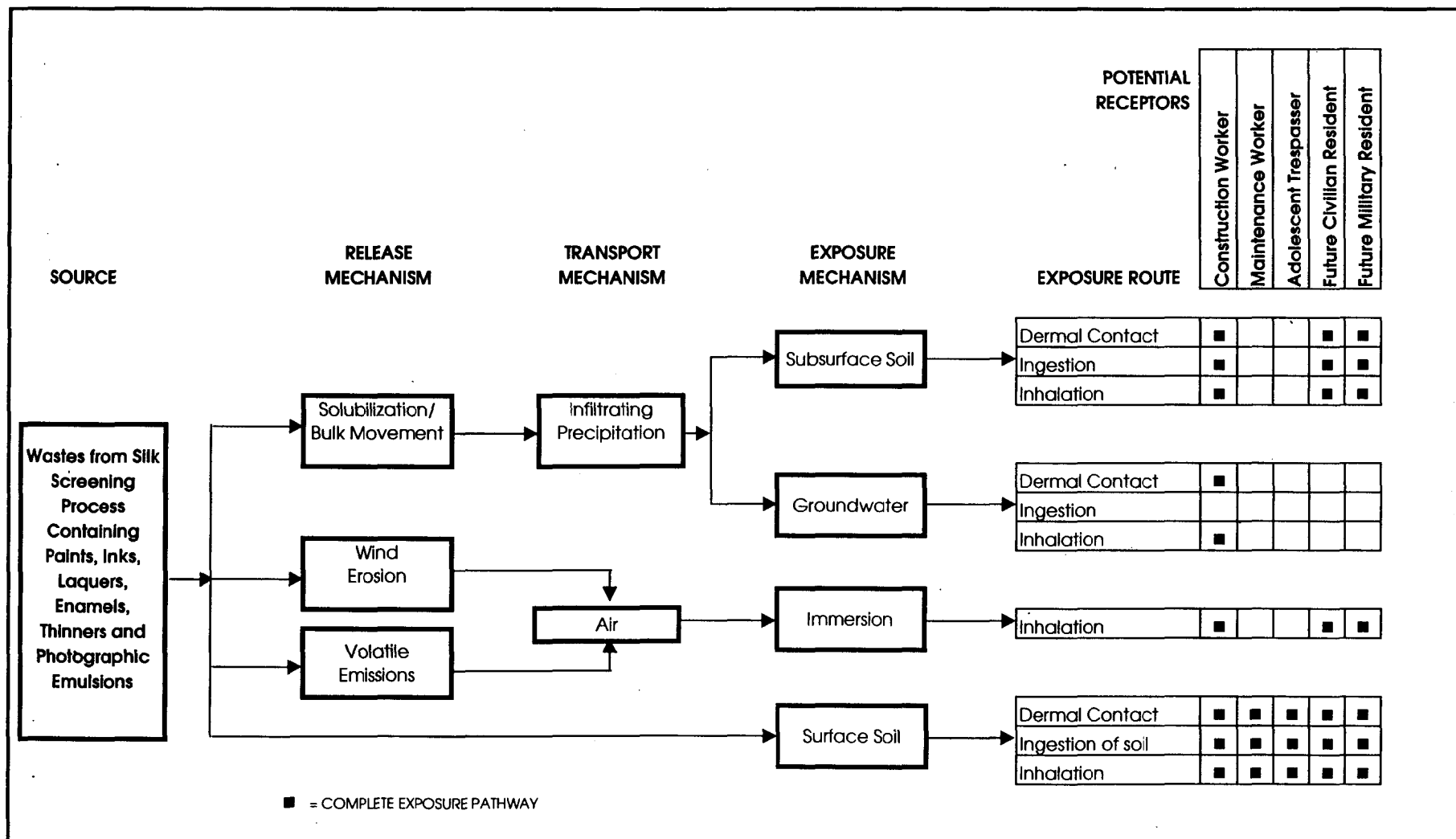
Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/. Office of Research and Development, August.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 7 - FIGURE 1

HUMAN HEALTH CONCEPTUAL SITE MODEL  
 SITE 7 - FORMER SILK SCREENING SHOP  
 NTC GREAT LAKES, ILLINOIS



Blank space indicates incomplete exposure pathway or relatively insignificant, or not applicable potential exposure.



## REFERENCES

American Society for Testing and Materials (ASTM), 1997. Standard Guide for Risk-Based Corrective Action (RBCA), ASTM E 1739, West Conshohocken, Pennsylvania.

Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring, VanNostrand-Reinhold Company, New York, New York.

IEPA, 1996. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online March, 2001.

IEPA, 1999. Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, Part 302, Water Quality Standards.

IEPA, 2000, Tiered Approach for Evaluation and Remediation of Product Releases to Sediments, September.

Department of the Navy, 2001 Conducting Human Health Risk Assessments under the Environmental Restoration Program. Ser N453E/1U595168. Washington, D.C., February.

National Library of Medicine, 2001. TOXNET, Hazardous Substance Data Base (HSDB), accessed online at <http://toxnet.nlm.nih.gov/cgi/sis>.

U.S. Department of Energy, 2001. Risk Assessment Information System (RAIS), Office of Environmental Management, Oak Ridge Operations (ORO), accessed online at [http://risk.lsd.ornl.gov/rap\\_hp.shtml](http://risk.lsd.ornl.gov/rap_hp.shtml).

U.S. EPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C., December.

U.S. EPA, 1991a. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. Washington, D.C., March.

U.S. EPA, 1991b. Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals, Interim. Publication 9285.7-01B, Office of Emergency and Remedial Response, Washington, D.C., December.

U.S. EPA, 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication No. 9285.7-081. Washington, D.C., May.

U.S. EPA, 1993a. Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C., May.

U.S. EPA, 1993b. Provisional Guidance for Quantitative Risk Assessment of Polynuclear Aromatic Hydrocarbons, EPA/600/R-93/089, Environmental Criteria and Assessment Office, Washington, D.C., July.

U.S. EPA, 1994a. Revised Interim Soil Lead for CERCLA Sites and RCRA Corrective Action Facilities. Directive 9355.4-12, Office of Solid Waste and Emergency Response, Washington, D.C., July.

U.S. EPA, 1994b. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children, EPA/540/R-93/081, Office of Emergency and Remedial Response, Washington, D.C. February.

U.S. EPA, 1996a. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response. Washington, D.C., May.

U.S. EPA, 1996b. Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Lead Exposure in Soil. Technical Review Workgroup for Lead. December.

U.S. EPA, 1997a. Exposure Factors Handbook. EPA/600/P-95/002Fa. Office of Health and Environmental Assessment, Washington, D.C., August.

U.S. EPA, 1997b. The Lognormal Distribution in Environmental Applications. Technology Support Center Issue, EPA/600/R-97/006, Office of Solid Waste and Emergency Response, Washington, D.C., December.

U.S. EPA, 1997c. Health Effects Assessment Summary Tables (HEAST). July

U.S. EPA, 1998. Risk Assessment for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments. Publication 9285.7-01D, Washington, D.C., January.

U.S. EPA, 1999. National Recommended Water Quality Criteria, EPA 822-Z-99-001, Office of Water, Washington, D.C., April.

U.S. EPA, 2000a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance, Dermal Risk Assessment) Interim Guidance. Office of Emergency and Remedial Response, Washington, D.C.

U.S. EPA, 2000b. "Region 9 Preliminary Remediation Goals (PRGs)", EPA Region IX, 75 Hawthorne Street, San Francisco, California, 94105, November

U.S. EPA, 2000c. Risk-Based Concentration Table. EPA Region 3, 841 Chestnut Street, Philadelphia, Pennsylvania 19107, October.

U.S. EPA, 2000d. Drinking Water Standards and Health Advisories. EPA 822-B-00-001, Office of Water, Washington, D.C. Summer.

U.S. EPA, 2001. Integrated Risk Information System (IRIS), accessed online.

## **I.2 SITE 17 PETTIBONE CREEK AND BOAT BASIN**

## **SITE 17 - HUMAN HEALTH RISK ASSESSMENT METHODOLOGY**

### **TABLE OF CONTENTS**

#### **1.0 DATA EVALUATION**

- 1.1 DATA USABILITY
- 1.2 SELECTION OF CHEMICALS OF POTENTIAL CONCERN (COPCS)
  - 1.2.1 COPC Screening Criteria
  - 1.2.2 Lead as a COPC
  - 1.2.3 Essential Nutrients and Chemicals without Toxicity Criteria
  - 1.2.4 Determination of Site-Related Chemicals
- 1.3 COPC SUMMARY SCREENING TABLES

#### **2.0 EXPOSURE ASSESSMENT**

- 2.1 CONCEPTUAL SITE MODEL (CSM)
  - 2.1.1 Site Sources of Contamination
  - 2.1.2 Contaminant Release Mechanisms and Transport/Migration Pathways
  - 2.1.3 Exposure Routes
  - 2.1.4 Potential Receptors
- 2.2 CENTRAL TENDENCY EXPOSURE VS. REASONABLE MAXIMUM EXPOSURE
- 2.3 EXPOSURE POINT CONCENTRATIONS (EPCS)
- 2.4 CHEMICAL INTAKE ESTIMATION
  - 2.4.1 Dermal Contact with Sediment
  - 2.4.2 Incidental Ingestion of Sediment
  - 2.4.3 Dermal Contact with Surface Water
  - 2.4.4 Ingestion of Surface Water
  - 2.4.5 Fish Ingestion
- 2.5 EXPOSURE TO LEAD

#### **3.0 TOXICITY ASSESSMENT**

- 3.1 TOXICITY CRITERIA
- 3.2 TOXICITY CRITERIA FOR DERMAL EXPOSURE
- 3.3 TOXICITY CRITERIA FOR CARCINOGENIC EFFECTS OF POLYNUCLEAR AROMATIC HYDROCARBONS (PAHS)
- 3.4 TOXICITY CRITERIA FOR CHROMIUM
- 3.5 TOXICITY PROFILES

#### **4.0 RISK CHARACTERIZATION**

- 4.1 QUANTITATIVE ANALYSIS
- 4.2 COMPARISON OF QUANTITATIVE RISK ESTIMATES TO BENCHMARKS

#### **5.0 UNCERTAINTY ANALYSIS**

- 5.1 UNCERTAINTY IN DATA EVALUATION
- 5.2 UNCERTAINTY IN THE EXPOSURE ASSESSMENT
- 5.3 UNCERTAINTY IN THE TOXICITY ASSESSMENT
- 5.4 UNCERTAINTY IN THE RISK CHARACTERIZATION

## **TABLES**

### **NUMBER**

- 1 Occurrence, Distribution and Selection of Chemicals of Potential Concern
- 2 Exposure Routes for Quantitative Evaluation
- 3 Values Used for Daily Intake Calculations for Exposure of Adolescent Recreational Users to Surface Water
- 4 Values Used for Daily Intake Calculations for Exposure of Adult Recreational Users to Surface Water
- 5 Values Used for Daily Intake Calculations for Exposure of Adolescent Recreational Users to Sediment
- 5 Values Used for Daily Intake Calculations for Exposure of Adult Recreational Users to Sediment
- 5 Values Used for Daily Intake Calculations for Exposure of Adult Recreational Users by Ingestion of Fish

## **FIGURES**

### **NUMBER**

- 1 Human Health Conceptual Site Model

## SITE 17 - HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

This section of the QAPP outlines the general methodologies and procedures that will be used to conduct a Baseline Human Health Risk Assessment for Site 17 (Pettibone Creek and the Boat Basin) located at Naval Training Center (NTC) Great Lakes. The objective of the risk assessment is to determine whether detected concentrations of chemicals at the site pose a significant threat to potential human receptors under current and/or future land uses. The potential risks to human receptors will be estimated based on the assumption that no further actions are taken to control contaminant releases.

The following risk assessment guidance documents were used to develop the framework for the Baseline Human Health Risk Assessment:

- U.S. EPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C.
- U.S. EPA, 1991a. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. Washington, D.C.
- U.S. EPA, 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication No. 9285.7-081. Washington, D.C.
- U.S. EPA, 1993a. Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C.
- U.S. EPA, 1996a. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response. Washington, D.C.
- U.S. EPA, 1997a. Exposure Factors Handbook. EPA/600/P-95/002Fa. Office of Health and Environmental Assessment, Washington, D.C.
- U.S. EPA, 2000a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance, Dermal Risk Assessment) Interim Guidance. Office of Emergency and Remedial Response, Washington, D.C.

- IEPA, 1996. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online March, 2001.
- Department of the Navy, 2001 Conducting Human Health Risk Assessments under the Environmental Restoration Program. Ser N453E/1U595168. Washington, D.C.

The risk assessment will be structured and reported according to the guidelines of the Risk Assessment for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D) (U.S. EPA, 1998).

A Baseline Human Health Risk Assessment has five components: (1) Data Evaluation, (2) Exposure Assessment, (3) Toxicity Assessment, (4) Risk Characterization, and (5) Uncertainty Analysis.

Three major aspects of chemical contamination and environmental fate and transport must be considered to evaluate potential risks: (1) contaminants with toxic characteristics must be found in environmental media and must be released by either natural processes or by human action, (2) potential exposure points must exist, and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the factors listed above is absent from a site, the exposure route is regarded as incomplete, and no potential risks will be considered to exist for human receptors.

## 1.0 DATA EVALUATION

Data evaluation, the first component of a Human Health Risk Assessment, involves the compilation and evaluation of analytical data. The main objective of the data evaluation is to develop a media-specific list of chemicals of potential concern (COPCs), that will be used to quantitatively determine potential human health risks for site media.

A "data evaluation/useability" section will precede the actual risk assessment in the report. The evaluation will address such issues as the adequacy of detection limits achieved in the environmental investigations. As noted in RAGS Part D, "data quality is an important component of the risk assessment and the data quality should be documented." Data quality will be evaluated as follows:

- To the extent available, the results of data validation conducted for the data sets used in the baseline risk assessment will be summarized and presented.



- To the extent that the information is available, the "Data Useability Worksheet" suggested in RAGS Part D will be completed.
- The data evaluation narrative will discuss data quality issues identified during the completion of the "Data Useability Worksheet."

### 1.1 **Data Usability**

Data collected during the proposed field investigation will be used to assess risks to potential human receptors. The analytical data used in the quantitative estimation of potential risks will be subjected to data validation. A discussion of data validation protocol is provided in the QAPP. As stated above, a Data Evaluation/Useability Report will be generated for the results of the field investigation. This report will provide information on precision, accuracy, representativeness, completeness, and comparability. A brief summary of the results of the data validation also will be included.

Quantitative or qualitative analytical results from the target analyte lists for the proposed field investigation will be used in the risk evaluation. Field measurements, data regarded as unreliable (i.e., qualified as "R" during the data validation process), and results of Tentatively Identified Compound (TIC) analyses will not be used in the quantitative risk assessment. However, these data may be used to substantiate the conclusions of the quantitative risk analysis.

Because of uncertainties associated with data quality, historical data collected during previous investigations will not be used to quantitatively assess potential risks at Site 7. The quality of the historical data is not completely documented and some of the data may not have been validated. However, these data may be used in a qualitative fashion to support the conclusions of the quantitative risk analysis. The proposed field investigation was developed to be comprehensive (i.e., locations sampled historically, as well as locations selected to close data gaps, were included); thus, the uncertainty associated with the elimination of the historical data from the quantitative risk assessment will not be significant.

### 1.2 **Selection of Chemicals of Potential Concern (COPCs)**

COPCs are selected through a qualitative screening process in order to limit the number of chemicals and exposure routes quantitatively evaluated in the Baseline Human Health Risk Assessment to only those site-related constituents that dominate overall potential risks. Screening by use of risk-based

concentrations and Illinois Environmental Protection Agency (IEPA) background levels will be used to focus the risk assessment on meaningful chemicals and exposure routes.

In general, a chemical will be selected as a COPC and retained for further quantitative risk evaluation if (1) the maximum detection in a sampled medium exceeds the lowest risk-based concentration and (2) the chemical is determined to be present at concentrations exceeding background. Chemicals eliminated from further evaluation at this time are assumed to present nominal risks to potential human receptors.

#### **1.2.1 COPC Screening Criteria**

Several screening criteria will be used to identify COPCs for Site 17. Screening concentrations based on risk-based cleanup objectives developed by IEPA (IEPA, 1996) and risk-based concentrations developed by U.S. EPA Region 9 (referred to as PRGs) (U.S. EPA, 2000b) will be used, as well as other U.S. EPA and IEPA criteria. The risk-based screening concentrations correspond to a systemic hazard quotient of 0.1 for noncarcinogens or an incremental lifetime cancer risk of  $1 \times 10^{-6}$  for carcinogens. Note that the IEPA and Region 9 Preliminary Remediation Goals (PRGs) for noncarcinogens are based on a hazard quotient of 1.0 while the screening concentrations will be based on a hazard quotient of 0.1. The screening concentrations are based on a hazard quotient of 0.1 so that additive noncarcinogenic risks for the chemicals do not exceed 1.0. The screening levels to be used for each medium in the risk assessment are briefly discussed below.

##### Screening Levels for Sediment

Screening levels are currently not available for human exposure to sediment. Therefore, risk-based concentrations for residential soil will be used as the basis of the sediment screening levels. The use of residential soil screening levels for sediment COPC identification is regarded as a conservative approach because exposure to sediment is expected to be less than exposure to soil. For example, the residential soil screening levels assume that a potential receptor is exposed to chemicals in soil 350 days per year. It is unlikely that a receptor would be exposed to sediment at this frequency in the Great Lakes area because of the long cold winters. In addition, the residential screening levels for noncarcinogens are conservatively based on the exposure of young children (0 to 6 years of age) to chemicals in soil. It is highly unlikely that very young children would be able to gain access to the sediments in Pettibone Creek and the Boat Basin on the continuous basis assumed by the screening levels. Therefore, applying residential soil screening levels to sediment is extremely conservative.

COPCs will be selected for sediment by comparing detected site concentrations to screening levels based on the following:

- IEPA Tier 1 Soil Remediation Objectives for Residential Properties (IEPA, 1996b) for the Soil Ingestion Exposure Route.
- U.S. EPA Region 9 PRGs for Residential Soil (U.S. EPA, 2000b).

If the maximum concentration of a constituent exceeds any of these criteria (and the constituent is considered to be present at concentrations greater than the concentrations of inorganic chemicals in background sediment provided in IEPA's Tiered Approach for Evaluation and Remediation of Product Releases to Sediments (IEPA, 2000), the chemical will be selected as a COPC for sediment and carried through to the quantitative risk assessment. The maximum sediment concentrations will be compared to the concentrations of inorganic chemicals provided by IEPA in Appendix A, Table G of TACO (IEPA, 1996). A diagram of the COPC selection process for sediment is provided in Section A of the QAPP.

U.S. EPA Generic SSLs for transfers from soil to air and for migration to groundwater are not considered to be appropriate for sediment screening because of high moisture content associated with sediment matrices.

#### Screening Concentrations for Surface Water

COPCs in surface water will be selected by comparing maximum concentrations with IEPA and U.S. EPA ambient water quality and drinking water criteria. The use of drinking water and ambient water-quality criteria (AWQC) screening levels for surface water is a highly conservative approach to COPC selection because surface water in Pettibone Creek is not currently used and will not be used in the future as a potable drinking water source. In addition, potential human exposure to surface water at Site 17 is expected to be limited to incidental exposures (such as that which occurs during periodic recreational use), which is significantly less than the daily exposure assumed during the development of the tap water screening criteria. The following screening criteria will be used to select COPCs for surface water in Pettibone Creek and the Boat Basin:

- IEPA Tier 1 Groundwater Remediation Objectives for Class 1 Groundwater (IEPA, 1996c).
- U.S. EPA Region 9 PRGs for Tap Water (U.S. EPA, 2000b).
- U.S. EPA MCLs (U.S. EPA, 2000d).
- Federal (U.S. EPA, 1999) and State (IEPA, 1999) AWQC for ingestion of water and fish.

If the maximum concentration of a constituent exceeds any of these criteria, the chemical will be selected as a COPC and carried through to the quantitative risk assessment.

#### Screening Concentrations for Ingestion of Fish

COPCs in fish tissue (assumed caught in Pettibone Creek or the Boat Basin) will be identified by comparing calculated fish tissue concentrations with screening levels based on U.S. EPA Region 3 RBCs (U.S. EPA, 2000c) for fish ingestion. The Region III RBCs are based on the assumption that a receptor ingests 54 grams of fish per day, 350 days per year for 30 years and that one hundred percent of the fish ingested is from the contaminated source. The use of the Region 3 screening levels is considered conservative because it is unlikely that fish caught in Pettibone Creek or the Boat Basin would constitute a significant fraction of an individual's diet. Because no actual fish tissue data will be available, concentrations in fish tissue will be calculated by multiplying maximum detected sediment concentrations by chemical-specific biota sediment accumulation factors (BSAFs).

#### **1.2.2 Lead as a COPC**

Limited criteria are available to evaluate the potential risks associated with lead. There are no risk-based concentrations for this chemical because the U.S. EPA has not derived toxicity values for lead. However, recommended screening levels for lead in soil are used to indicate the need for response activities. Guidance from both the Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and the Office of Solid Waste and Emergency Response (OSWER) recommend 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting, where children are frequently present (U.S. EPA, 1994a). Applying the OSWER screening level for sediments is conservative because the screening level is based on residential exposure to soil by young children (0 to 6 year of age). A more suitable screening level would be the 2,000 to 5,000 mg/kg range identified by OPPTS as an appropriate range for areas where contact with soil by children in a residential setting is less frequent.

At this time, no screening level is available for non-residential exposure to lead in surface water. Therefore, the Safe Drinking Water Act (SDWA) Action Level at the tap of 15 µg/L (U.S. EPA, 2000d) will be used as the screening level for lead in surface water. The use of the SDWA screening level, which is based on the assumption of daily residential use (ingestion of 2 liters of water per day), for surface water is a conservative selection because surface water in Pettibone Creek is not currently used and will not be used in the future as a potable drinking water source. In addition, potential human exposure to surface water at Site 17 is expected to be limited to incidental exposures (such as that which occurs during

periodic recreational use), which is significantly less than the daily exposure assumed for the SDWA screening level.

### **1.2.3 Essential Nutrients and Chemicals without Toxicity Criteria**

The essential nutrients calcium, magnesium, potassium, and sodium will not be identified as COPCs for Site 17. These inorganic chemicals are naturally abundant in environmental matrices and are only toxic at high doses and, because of the lack of toxicity criteria, risk-based COPC screening levels are not available for these chemicals.

### **1.2.4 Determination of Site-Related Chemicals**

Chemicals found at concentrations indicative of background concentrations are not considered to be site-related contaminants and will not be retained as COPCs for the quantitative risk assessment. In order to determine whether inorganic chemicals in sediment are present at concentrations greater than background, the maximum concentrations of inorganic chemicals will be compared to background concentrations provided by IEPA in the Tiered Approach for Evaluation and Remediation of Product Releases to Sediments (IEPA, 2000).

Only inorganic chemicals will be eliminated based on background data for sediment. Some organic compounds are often found at low concentrations in background samples and the detected concentrations usually reflect non-site related, anthropogenic sources of contamination (e.g., automobile exhausts). All detected organic compounds will be regarded as site-related for purposes of COPC selection. However, historical information and information from this investigation will be reviewed in the risk assessment to determine whether the organic chemicals present in the site samples are attributable to site-related activities or other anthropogenic sources. The results of this qualitative analysis will be discussed in the uncertainty section of the risk assessment.

## **1.3 COPC Summary Screening Tables**

Media-specific tables summarizing the selection of COPCs will be included in the risk assessment. The tables will be prepared according to the guidelines established for preparation of Standard Table 2 of the RAGS Part D guidance. An example format of a typical COPC selection table is provided as Table 1.

## **2.0 EXPOSURE ASSESSMENT**

The exposure assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, identify potentially exposed populations and applicable exposure pathways, determine concentrations of COPCs to which receptors might be exposed, and estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures at Site 17 will be determined based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components: (1) a source of chemicals that can be released to the environment, (2) a route of contaminant transport through an environmental medium, and (3) an exposure or contact point for a human receptor.

### **2.1 Conceptual Site Model (CSM)**

The development of a CSM is an essential component of the exposure assessment. The CSM integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors to be evaluated in the risk assessment. A well-developed CSM will allow for a better understanding of the risks at a site and will aid the risk managers in the identification of the potential need for remediation. The site-specific CSM for Site 17 is presented in this section and illustrated in Figure 1. The model was used to develop the proposed field investigations so that the data collected meet the needs of the risk assessment. The CSM, which essentially defines the nature of the environmental problem at the site, depicts the relationships among the following elements:

- Site sources of contamination
- Contaminant release mechanisms
- Transport/migration pathways
- Exposure routes
- Potential receptors

The CSM will be refined during the risk assessment process using the data and information collected as part of the proposed field investigations. Table 2 presents a summary of the exposure routes that will be addressed quantitatively for each human receptor. A summary discussion of the CSM for Site 7 is provided in Section A of the QAPP.

The elements of the CSM, including how they pertain to Site 17, are presented in the following sections.

### **2.1.1 Site Sources of Contamination**

Site 17 consists of Pettibone Creek and the Boat Basin. The following sections present a brief description of these water bodies, the known sources of contamination, and the summary of the types of chemicals found in historical samples collected in the Creek and Boat Basin.

#### Pettibone Creek

The majority of the Great Lakes Naval Training Center (NTC) activities occur on a plateau atop a steep bluff that rises 70 feet above the beach. Pettibone Creek and its tributaries flow in a ravine, which divides this plateau, and discharge to the Boat Basin.

Pettibone Creek is a shallow creek of generally moderate flow (it is not continuously full of water) terminating in the Boat Basin. The creek has two major branches, the north and the south. The north branch originates in North Chicago near Commonwealth Avenue, flows south through the Vacant Lot, crosses under Martin Luther King Jr. Drive and a parking area, resurfaces north of Sheridan Road, flows below Sheridan Road, resurfaces on the Great Lakes NTC property, and flows south and east through the Great Lakes NTC until it enters Lake Michigan. The south branch originates in the Shore Acres Country Club and flows north entering Great Lakes NTC near the intersection of G Street and 3rd Street. The Pettibone Creek study area ranges from the culvert at the northern end of Pettibone Creek north branch and the golf course/NTC property limit of the south branch downstream to the west end of the bridge upstream of the boat basin.

In Great Lakes NTC, Pettibone Creek ranges between 15 and 30 feet in width, and several inches to six feet in depth with an average flow of less than 10 cubic feet-per-second (cfs). Some low lying banks and small "flood plains" are found within the main banks of the creek. The creek sometimes floods its immediate low lying banks within the main banks. The main banks are generally steep and about 3 to 10 feet high. Flooding over top the higher banks is not known to have occurred.

The site has received, or may have received, a variety of wastes from both upstream industries, road runoff, storm sewers (over 30 Great Lakes NTC stormwater sewer system outfalls are present along the creek banks), and from local residents. Most of the contamination originated near the headwaters of the north and south branches of Pettibone Creek. The upstream areas adjacent to industrial sites have been cleaned up and it is thought that additional releases to the creek should be insignificant. Nevertheless, there could be residual runoff into Pettibone Creek and one upstream outfall is still permitted under the

National Pollutant Discharge Elimination System. The stream sediments are contaminated with various compounds and elements and are classified as “Special Waste”.

Pettibone Creek is not used for drinking; however, children may play in the creek. While fish and frogs are present in the creek and fish may swim up the creek to spawn, there are no records of the occurrence of endangered or threatened species in the area. The highly developed nature of the general vicinity makes it unlikely that suitable habitat for such species is present. No natural areas have been identified near the creek and there are no dedicated Illinois nature preserves in the immediate vicinity.

The urban nature of the creek’s watershed has resulted in flash flood conditions, which have brought about severe erosion and sedimentation problems. A variety of efforts to stabilize the erosion of the ravine have been made. In 1982, the Great Lakes NTC initiated emergency slope stabilization. In 1989, after a period of major storms in 1987 and 1988, emergency pipe replacement and slope stabilization measures were taken in three severely eroded areas.

#### Boat Basin

The original harbor and Boat Basin were constructed in 1906 with the outer breakwater structures added by 1923. Extensive erosion into Pettibone Creek is contributing to the silting-in of the harbor. The most recent dredging operations of the harbor were in the early 1950s and the early 1970s. The Harbor Area is divided into three areas: the Boat Basin, the Inner Harbor, and the Outer Harbor.

The Boat Basin, which is approximately 2.6 acres, is the most protected portion of the Harbor, extending from the west end of the bridge upstream of the Boat Basin to the beginning of the inner harbor. It served as an area for boat slips when the water was deeper. In June 1990, the water depth of the Boat Basin ranged from less than one foot to five feet. Access to the boat repair building used to be through the eastern portion of the Boat Basin, but, now, most vessels cannot access the boat repair building due to accumulated sediment. The Boat Basin was last dredged in 1972 and, therefore, sediments currently present in the basin have been accumulating over the past 30 years. A large depression was dredged at the end of Pettibone Creek near the boat basin spillway to serve as a sediment trap. Sediment can be removed relatively easily from this trap on a periodic basis. It has been estimated that some 30,000 cubic yard of material would have to be dredged from the boat basin to reestablish a desired water depth of 8 feet. Evidence from aerial photographs indicates that the boat basin would require dredging about once every 5-7 years.



Previous sampling and analyses have found various classes of contaminants in the sediments and water of Pettibone Creek and the Boat Basin. These include VOCs, PAHs, pesticides, PCBs, and metals. The concentrations of copper, cyanide, lead, nickel, and zinc in Pettibone Creek and Boat Basin sediment samples exceeded the 1977 U.S. EPA guidelines for classifying Great Lakes harbor sediments as “nonpolluted.”

### **2.1.2 Contaminant Release Mechanisms and Transport/Migration Pathways**

As described previously, past releases of wastes from upstream industries, storm sewers, and local residents, and road runoff are thought to have impacted Pettibone Creek and, ultimately, the Boat Basin. Once released from the source, the contaminants could be transported in surface water or sediment. The contaminants could be deposited on soil/sediment in the low lying banks of Pettibone Creek or they might be transported to the Boat Basin where they could accumulate in the sediments over time. Chemicals in surface water or sediment may also bioaccumulate in aquatic animals in the Creek and Boat Basin.

Potential receptors may be exposed either directly or indirectly to contaminants in surface water or sediment by several exposure mechanisms, such as direct contact or ingestion, or indirectly by the ingestion of fish.

Based on information regarding past chemical releases at the site, plausible contaminant release and migration mechanisms include the following:

- Deposition of chemicals in surface water and sediment on the banks of Pettibone Creek
- Transport of chemicals in surface water and sediment in Pettibone Creek to the surface water and sediment of the Boat Basin.
- Bioaccumulation of chemicals in the surface water and sediment of Pettibone Creek and the Boat Basin into aquatic animals.

### **2.1.3 Exposure Routes**

The manner in which a receptor comes into contact with contaminants is generally the result of interactions between a receptor's behavior or lifestyle and contaminated medium. Potential receptors could come into contact with potentially contaminated surface water and sediment. Brief explanations of the potential routes of exposure per media are provided in this section.

### Surface Water and Sediment

Potential receptors may come into direct contact with surface water and sediment (0 to 4 inches deep) in Pettibone Creek or the Boat Basin. Individuals may be exposed primarily via dermal contact and incidental ingestion but the frequency of exposure is expected to be less than typical residential or industrial exposures. Exposure via inhalation is expected to be minimal and will not be quantitatively evaluated in the risk assessment.

### Fish Tissue

Potential recreational receptors may ingest fish caught in Pettibone Creek or the Boat Basin. Ingestion of fish is a more likely exposure route in the Boat Basin, as individuals have been observed fishing in the Boat Basin. Fish ingestion will be evaluated with reference to information on recreational fish ingestion presented in the U.S. EPA's Exposure Factor Handbook (U.S. EPA, 1997a). For example, studies in the Exposure Factors Handbook provide estimates of the amount of recreationally caught fish ingested by fisherman in the United States.

#### **2.1.4 Potential Receptors**

Potential receptors could be exposed to surface water or sediment at Site 17 under current and future land uses. These receptors have been identified by analyzing current land use practices, potential future land use, and the identified areas of contamination in order to focus the risk assessment on potential site-related exposures. The general receptor classes are:

- Adult and adolescent recreational users - Potential receptors under current/future land uses. These receptors will be evaluated for exposure to surface water and sediment in Pettibone Creek and the Boat Basin. Exposure to surface water and sediment will be evaluated for incidental ingestion and dermal exposure. Swimming is not known to occur and has not been observed in the Boat Basin. Therefore, the dermal exposure scenario will assume that receptors are exposed only while wading. Adult recreational users will also be evaluated for ingestion of fish assumed caught in Pettibone Creek and the Boat Basin.

#### **2.2 Central Tendency Exposure (CTE) vs. Reasonable Maximum Exposure (RME)**

Traditionally, exposures evaluated in the human health risk assessment were based on the concept of a RME only, which is defined as "the maximum exposure that is reasonably expected to occur at a site"

(U.S. EPA, 1989). However, recent risk assessment guidance (U.S. EPA, 1993a) indicates the need to address an average case or CTE.

To provide a full characterization of potential exposure, both RME and CTE will be evaluated in the risk assessment for Site 17. The available guidance (U.S. EPA, 1993a) concerning the evaluation of CTE is limited. Therefore, professional judgment will be exercised when defining CTE conditions for a particular receptor at a site.

### **2.3 Exposure Point Concentrations (EPC)**

The exposure point concentration, calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time by a receptor and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL), which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (U.S. EPA, 1992). The 95 percent UCL will be used as the exposure concentration to assess RME and CTE risks (U.S. EPA, 1993a). For data sets with less than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration will be defined as the maximum detected concentration.

Conventional statistical methods (i.e., the Shapiro-Wilk W-Test) will be used to determine the distribution and UCL of a particular data set (Gilbert, 1987; U.S. EPA, 1992). Detailed sample calculations, as well as general methodology for the statistical evaluation, will be presented in the site-specific risk assessments. Nondetected data points will be utilized; in general, one-half the sample-specific detection limit will be employed for these analytical results.

The fish tissue concentrations used in risk assessment calculations will be based on measured sediment data. The 95 percent UCL or maximum concentration for sediment will be multiplied by a chemical-specific biota sediment accumulation factors (BSAFs) to estimate a chemical concentration in fish tissue.

The following guidelines will be used to calculate the EPCs:

- Site 17 will be subdivided into “the creek” and “the boat basin” because water flow and physical characteristics, as well as use by human receptors, within these two areas are different.
- If a data set contains less than 10 samples, the EPC for the RME and CTE cases will be defined as the maximum detected concentration.

- If a data set contains 10 or more samples, the 95 UCL on the arithmetic mean, based on the distribution of the data set, will be selected as the EPC for the RME and CTE cases. Conventional statistical methods (e.g., the Shapiro-Wilk W-Test, the t- and H-statistic based UCL calculation) will be used to determine the distribution and UCL. The “best fit” distribution (normal or lognormal) will be assumed if the data set distribution is undefined. However, the EPCs calculated assuming a lognormal distribution will be reviewed and re-calculated (if necessary), as recommended in U.S. EPA guidance (U.S. EPA, 1997b) so that the H-statistic based UCL is not an over-prediction of the EPC. If the calculated 95 percent UCL exceeds the maximum detected concentration, the maximum concentration will be used as the EPC. If enough data are available and a qualified statistician judges that Jackknife or Bootstrap procedures would present a more realistic estimation of risk, these techniques, which are described in the U.S. EPA (1997b), may be used. Bootstrap and Jackknife procedures are nonparametric statistical techniques which can be used to reduce the bias of point estimates and construct approximate confidence intervals for parameters such as the population mean. These procedures require no assumptions regarding the statistical distribution (e.g., normal or lognormal) of the data and can be applied to a variety of situations, no matter how complicated. The Bootstrap and Jackknife procedures, which are based on resampling techniques, are conceptually simple, but require considerable computing power and time.

## **2.4      Chemical Intake Estimation**

The methodologies and techniques used to estimate exposure via ingestion and dermal contact are presented in this section of the Work Plan. Intakes for the identified potential receptor groups will be calculated using U.S. EPA risk assessment guidance (U.S. EPA, 1989 and 2000a) and presented in the risk assessment spreadsheets which will be appended to the risk assessment as support documentation.

Noncarcinogenic intakes will be estimated using the concept of an average annual exposure. Carcinogenic intakes will be calculated as an incremental lifetime exposure, that will assume a life expectancy of 70 years. Equations used to calculate estimated intakes are provided below. Values of the exposure parameters and assumptions regarding exposure for receptors and exposure pathways are presented in Table 3 through Table 7.

### **2.4.1      Dermal Contact with Sediment**

Direct physical contact with sediment may result in the dermal absorption of chemicals. Exposures associated with the dermal route are estimated using the following equation (U.S. EPA, 1989 and 2000a):

$$Intake_{si} = (C_{si})(SA)(AF)(ABS)(CF)(EF)(ED) / (BW)(AT)$$

where:

$Intake_{si}$	=	amount of chemical "i" absorbed during contact with sediment (mg/kg/day)
$C_{si}$	=	concentration of chemical "i" in sediment (mg/kg)
SA	=	skin surface area available for contact (cm <sup>2</sup> /day)
AF	=	skin adherence factor (mg/cm <sup>2</sup> )
ABS	=	absorption factor (dimensionless)
CF	=	conversion factor (1E-6 kg/mg)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days); for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yrs x 365 days/yr

Exposed surface areas of body available for dermal contact are determined for each receptor based on assumed human activities and clothing worn during exposure events. U.S. EPA guidance (U.S. EPA, 1997a and 2000a) are used to develop the default assumptions concerning the amount of skin surface area available for contact for a receptor. The skin surface areas that will be used in risk assessment calculations and the rationale for the selection of the surface areas are as follows:

- For adolescent recreational users, 25 percent of the total body surface area of an adolescent (aged 7 to 16) will be assumed to be available for surface water and sediment contact. The RME value (3,820 cm<sup>2</sup>) is derived from the 95th percentile surface area data and the CTE value (3,100 cm<sup>2</sup>) is derived from the 50th percentile data, as provided in Table 6-6 of the Exposure Factors Handbook (U.S. EPA, 1997a).
- For adult recreational users, the feet, lower legs, hands, and arms of an adult male are assumed available for surface water and sediment contact. The RME value (9,190 cm<sup>2</sup>) and the CTE value (7,770 cm<sup>2</sup>) are derived from the 95<sup>th</sup> and 50<sup>th</sup> percentile surface areas of an adult male, respectively, as provided in Table 6-2 of the Exposure Factors Handbook (U.S. EPA, 1997a).

Values of soil adherence factors and chemical-specific dermal absorption factors provided in RAGS Part E (U.S. EPA, 2000a) will be used to evaluate risks from exposure to sediment for adults and adolescents. A soil adherence factor of  $0.3 \text{ mg/cm}^2$  will be used for the RME and  $0.04 \text{ mg/cm}^2$  for the CTE. These adherence factors were derived from teens playing in moist conditions (Exhibit 3.3, U.S. EPA, 2000a) and are considered to be representative of adolescent exposure to sediment.

The following absorption factors will be used for the RME and CTE exposure scenarios:

- PCBs – 0.14
- PAHS – 0.13
- DDD, DDE, and DDT – 0.03
- Chlordane – 0.04
- Lindane – 0.04
- Arsenic – 0.03
- Cadmium – 0.001
- Semivolatile Organics – 0.1
- Other Inorganics and Volatile Organics – not evaluated for dermal contact with soil (U.S. EPA, 2000a)

#### 2.4.2 Incidental Ingestion of Sediment

Incidental ingestion of sediment by potential receptors is assumed to coincide with dermal exposure. Exposures associated with incidental ingestion are estimated in the following manner (U.S. EPA, 1989):

$$Intake_{si} = (C_{si})(IR_s)(FI)(EF)(ED)(CF) / (BW)(AT)$$

where:

$Intake_{si}$	=	intake of contaminant "i" from sediment (mg/kg/day)
$C_{si}$	=	concentration of contaminant "i" in sediment (mg/kg)
$IR_s$	=	ingestion rate (mg/day)
$FI$	=	fraction ingested from contaminated source (dimensionless)
$EF$	=	exposure frequency (days/yr)
$ED$	=	exposure duration (yr)
$CF$	=	conversion factor ( $1E-6 \text{ kg/mg}$ )
$BW$	=	body weight (kg)
$AT$	=	averaging time (days);

for noncarcinogens,  $AT = ED \times 365 \text{ days/yr}$ ;

for carcinogens,  $AT = 70 \text{ yrs} \times 365 \text{ days/yr}$

Ingestion rates for the recreational users are set at 100 mg/day for the RME and 50 mg/day for the CTE (U.S. EPA, 1993a). The same exposure frequencies and durations used in the estimation of dermal intakes will be used to estimate exposure via incidental ingestion. A default value of 1.0 (U.S. EPA, 1989) will be used for the fraction of sediment ingested from the contaminated source for the RME and CTE scenarios.

### 2.4.3 Dermal Contact with Surface Water

Dermal contact with surface water may occur while receptors are involved in recreational activities in Pettibone Creek or the Boat Basin. The following equation will be used to assess exposures resulting from dermal contact with surface water (U.S. EPA, 2000a):

$$DAD_{wi} = (DA_{event})(EV)(ED)(EF)(A) / (BW)(AT)$$

where:

$DAD_{wi}$	=	dermally absorbed dose of chemical "i" from water (mg/kg/day)
$DA_{event}$	=	absorbed dose per event (mg/cm <sup>2</sup> -event)
EV	=	event frequency (events/day)
ED	=	exposure duration (yr)
EF	=	exposure frequency (days/yr)
A	=	skin surface area available for contact (cm <sup>2</sup> )
BW	=	body weight (kg)
AT	=	averaging time (days);
		for noncarcinogens, $AT = ED \times 365 \text{ days/yr}$ ;
		for carcinogens, $AT = 70 \text{ yrs} \times 365 \text{ days/yr}$

The absorbed dose per event ( $DA_{event}$ ) will be estimated using a nonsteady-state approach for organic compounds and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^*, \text{ then : } DA_{event} = (2FA)(K_p)(C_{gw})(CF) \left( \frac{\sqrt{6T_{event}}}{\pi} \right)$$

$$\text{If } t_{\text{event}} > \bar{t}, \text{ then: } DA_{\text{event}} = (FA)(K_p)(C_{\text{gw}})(CF) \left( \frac{t_{\text{event}}}{1+B} + 2T \left( \frac{1+3B+3B^2}{(1+B)^2} \right) \right)$$

where:

$t_{\text{event}}$	=	duration of event (hr/event)
FA	=	fraction absorbed (dimensionless)
$\bar{t}$	=	time it takes to reach steady-state conditions (hr)
$K_p$	=	permeability coefficient from water through skin (cm/hr)
$C_{\text{wi}}$	=	concentration of chemical "i" in water (mg/L)
$T$	=	lag time (hr)
$\pi$	=	constant (dimensionless; equal to 3.1416)
CF	=	conversion factor ( $1 \times 10^{-3}$ L/cm <sup>3</sup> )
B	=	partitioning constant derived by Bunge Model (dimensionless)

Values for the chemical-specific parameters ( $\bar{t}$ ,  $K_p$ ,  $T$ , and  $B$ ) will be obtained from the current dermal guidance (U.S. EPA, 2000a). If no published values are available for a particular compound, they will be calculated using equations provided in the cited guidance. The exposure times for the recreational users are assumed to be 4 hours per day for the RME and 2 hours per day for the CTE, based on professional judgement. The recreational users will be assumed to be exposed 2 days per week in warm weather months for the RME (52 days/year) and 1 day a week in warm weather months for the CTE (26 days/year), based on professional judgement.

The following steady-state equation will be used to estimate  $DA_{\text{event}}$  for inorganics:

$$DA_{\text{event}} = (K_p) (C_{\text{wi}}) (t_{\text{event}})$$

The recommended default value of  $1 \times 10^{-3}$  will be used for the dermal permeability of inorganic constituents, unless a chemical-specific value is provided in the U.S. EPA guidance. For most metals, dermal absorption is not a significant pathway because penetration through the skin is minimal.



#### 2.4.4 Ingestion Surface Water

Direct contact with surface water while wading or exploring could result in the inadvertent ingestion of small amounts of water. Intakes associated with ingestion of surface water will be evaluated using the following equation (U.S. EPA, 1989):

$$\text{Intake}_{wi} = (C_{wi})(CR)(ET)(EF)(ED)/(BW)(AT)$$

where:

Intake <sub>wi</sub>	=	intake of chemical "i" from water (mg/kg/day)
C <sub>wi</sub>	=	concentration of chemical "i" in water (mg/L)
CR	=	contact rate for surface water (L/hr)
ET	=	exposure time for surface water (hr/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days); for noncarcinogens, AT = ED x 365 days/yr; for carcinogens, AT = 70 yrs x 365 days/yr

The same exposure times, frequencies, and durations used to assess dermal exposure to water will be used to estimate intakes for ingestion of water. A contact rate of 0.50 L/hour is used for the adult and adolescent recreational users (U.S. EPA, 1989).

#### 2.4.5 Fish Ingestion

The fish consumption exposure pathway is evaluated for adult recreational users. Since exposure for adolescent and adult recreational users is expected to be similar, exposure for the adolescent recreational users is not addressed quantitatively. Intakes for the fish ingestion exposure route are estimated using the following equation (U.S. EPA, 1989):

$$\text{Intake} = \frac{(C_{sed} \times BSAF \times IR \times FI \times EF \times ED)}{(BW \times AT)}$$

where: Intake	=	ingestion intake (mg/kg-day)
C <sub>sed</sub>	=	chemical concentration in sediment (mg/kg)

BSAF	=	chemical-specific biota sediment accumulation factor (unitless)
IR	=	ingestion rate (kg/meal)
FI	=	fraction ingested from contaminated source (unitless)
EF	=	exposure frequency (meals/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
		for noncarcinogens, $AT = ED \times 365 \text{ days/yr}$ ;
		for carcinogens, $AT = 70 \text{ yrs} \times 365 \text{ days/yr}$

The ingestion rates of contaminants in fish are assumed to be 0.025 kg/meal for the RME and 0.008 kg/meal for the CTE (U.S. EPA, 1997a). These daily ingestion rates are the values recommended by the U.S. EPA for recreational fisherman based on information from several studies cited in the U.S. EPA's Exposure Factors Handbook (Section 10.10.3, U.S. EPA, 1997a). The fraction ingested from the contaminated source (FI) will be assumed to be 0.25 (25%), as no specific information on the dietary habits of local residents is available. This assumes that 25 percent of the fish caught and ingested by the recreational fisherman comes from Pettibone Creek or the Boat Basin.

## 2.5 Exposure to Lead

The equations and methodology presented in the previous section cannot be used to evaluate exposure to lead because of the absence of published dose-response parameters. Exposure to lead by adult recreational users will be assessed using the U.S. EPA's Technical Review Workgroup for Lead (U.S. EPA, 1996b). In this model, adult exposure to lead in sediment is addressed by an evaluation of the relationship between the site sediment lead concentration and the blood lead concentration in the developing fetuses of adult women. The adult lead model will generate a spreadsheet for each exposure scenario evaluated (i.e., recreational users). The spreadsheets will calculate a range of 95<sup>th</sup> percentile fetal blood lead concentrations from central estimates of blood lead concentrations in pregnant adult women. The spreadsheets also calculate 95<sup>th</sup> percentile blood lead concentrations in fetuses born to women exposed to lead in sediment.

## 3.0 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to identify the potential health hazards and adverse effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects will be defined for the identified COPCs.

Quantitative toxicity values determined during this component of the risk assessment will be integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The toxicity value used to evaluate noncarcinogenic health effects is the Reference Dose (RfD). Carcinogenic effects are quantified using the Cancer Slope Factor (CSF).

### 3.1 Toxicity Criteria

Oral and inhalation RfDs and CSFs to be used in the site-specific risk assessment for Site 17 will be obtained from the following primary literature sources:

- Integrated Risk Information System (IRIS) (U.S. EPA, 2000 available online)
- Annual Health Effects Assessment Summary Tables (HEAST) (U.S. EPA, 1997c)
- NCEA Superfund Health Risk Technical Support Center

Although RfDs and CSFs can be found in several toxicological sources, U.S. EPA's IRIS online database is the preferred source of toxicity values. This database is continuously updated and values presented have been verified by U.S. EPA RfD and Carcinogenic Risk Assessment Verification Endeavor (CRAVE) work groups. The U.S. EPA Region 9 PRG tables and Region 3 Risk-Based Concentration (RBC) tables will also be used as a source of toxicity criteria.

### 3.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs found in literature may be expressed as administered doses; therefore, these values are considered to be inappropriate for estimating the risks associated with dermal routes of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made. Because this information is not always readily available, oral dose-response parameters will be adjusted to an absorbed dose using chemical-specific absorption efficiencies published in available guidance (U.S. EPA, 2000a) and the following equations:

$$RfD_{\text{dermal}} = (RfD_{\text{oral}})(ABS_{\text{GI}})$$

$$CSF_{\text{dermal}} = (CSF_{\text{oral}}) / (ABS_{\text{GI}})$$

where:

$ABS_{GI}$  = absorption efficiency in the gastrointestinal tract

Absorption efficiencies used in the risk assessments will reflect the U.S. EPA's current dermal assessment guidance (U.S. EPA, 2000a).

### **3.3 Toxicity Criteria for Carcinogenic Effects of Polynuclear Aromatic Hydrocarbons (PAHs)**

Limited toxicity values are available to evaluate the carcinogenic effects from exposure to PAHs. The most extensively studied PAH is benzo(a)pyrene, classified by the U.S. EPA as a known human carcinogen. Although CSFs are available for benzo(a)pyrene, insufficient data are available to calculate CSFs for other carcinogenic PAHs. Toxic effects of these chemicals will be evaluated using the concept of estimated orders of potential potency, as presented in U.S. EPA guidance (U.S. EPA, 1993b). These parameters are based on the carcinogenicity of benzo(a)pyrene and are available for select carcinogenic PAHs. The equivalent oral and inhalation CSF for these chemicals is derived by multiplying the CSF for benzo(a)pyrene by the order of potential potency.

### **3.4 Toxicity Criteria for Chromium**

Toxicity criteria are available for two different forms of chromium, the trivalent state and the hexavalent state, of which the latter is considered to be more toxic. The screening of chromium will be conducted assuming that 100 percent of the reported total chromium is hexavalent. Should chromium, assumed to be all hexavalent, prove to be a significant contributor to risk, further investigation regarding the presence and valence state of chromium may be necessary. The uncertainty associated with the assumption that all chromium is hexavalent chromium will be discussed in the uncertainty section of the risk assessment.

### **3.5 Toxicity Profiles**

Toxicological profiles for each COPC will be presented in an appendix to the risk assessment. These brief profiles will present a summary of the currently available literature on the carcinogenic and noncarcinogenic health effects associated with human exposure to the COPCs.

## 4.0 RISK CHARACTERIZATION

Potential risks (noncarcinogenic and carcinogenic) for human receptors resulting from the exposures outlined in the exposure assessment are quantitatively determined during the risk characterization component of the Baseline Human Health Risk Assessment.

A summary and interpretive discussion of the quantitative risk estimates will be provided in the text of the risk assessment. During the interpretive risk discussion, COPCs that contribute significantly to elevated risks will be identified as "risk drivers" or Chemicals of Concern (COCs). The numeric estimates of risk will be contained in the risk assessment spreadsheets that will be appended to the risk assessment as support documentation.

### 4.1 Quantitative Analysis

Quantitative estimates of risk will be calculated according to risk assessment methods outlined in U.S. EPA guidance (U.S. EPA, 1989). Lifetime cancer risks will be expressed in the form of dimensionless probabilities, referred to as incremental cancer risks (ICRs), based on CSFs. Noncarcinogenic risk estimates will be presented in the form of Hazard Quotients (HQs) that are determined through a comparison of intakes with published RfDs.

ICR estimates are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ICR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

If the above equation results in an ICR greater than 0.01, the following equation (U.S. EPA, 1989) will be used:

$$\text{ICR} = 1 - [\exp (-\text{Estimated Exposure Intake})(\text{CSF})]$$

An ICR of  $1 \times 10^{-6}$  indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

As mentioned previously, noncarcinogenic risks will be assessed using the concept of HQs and Hazard Indices (HIs). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows:

$$HQ = (\text{Estimated Exposure Intake}) / (\text{RfD})$$

An HI will be generated by summing the individual HQs for the COPCs. The HI is not a mathematical prediction of the severity of toxic effects and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

#### **4.2 Comparison of Quantitative Risk Estimates to Benchmarks**

Quantitative risk estimates will be compared to typical benchmarks to interpret the quantitative risks and to aid risk managers in determining the need for remediation at a site. Calculated ICRs will be interpreted using the U.S. EPA's "target range" ( $1 \times 10^{-4}$  to  $1 \times 10^{-6}$ ), while HIs will be evaluated using a value of 1.0.

The U.S. EPA has defined the range of  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  as the ICR "target range" for most hazardous waste facilities addressed under CERCLA and RCRA. Individual or cumulative ICRs greater than  $1 \times 10^{-4}$  will typically not be considered as protective of human health, while ICRs less than  $1 \times 10^{-6}$  will typically be regarded as protective. Risk management decisions are necessary when the ICR is within the  $1 \times 10^{-4}$  to  $1 \times 10^{-6}$  cancer risk range. Risks greater than  $1 \times 10^{-6}$  will be noted and discussed in the risk assessment.

An HI exceeding unity (1.0) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, a segregation of target organs effects associated with exposure to COPCs will be performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) will be regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1.0, but have no anticipated adverse health effects if the COPCs do not affect the same target organ or exhibit the same critical effect.

#### **5.0 UNCERTAINTY ANALYSIS**

The goal of the uncertainty analysis is to identify important uncertainties and limitations associated with the Baseline Human Health Risk Assessment. Uncertainties related to each component of the assessment (i.e., data evaluation, exposure assessment, toxicity assessment, and risk characterization) will be presented. In addition, the effect of a particular uncertainty on the outcome of the assessment (i.e., risk estimates) will also be discussed, where possible. The following subsections present an overview of uncertainties that may be addressed in the risk assessment uncertainty section.

### **5.1      Uncertainty in Data Evaluation**

This section may discuss uncertainties in the risk assessment associated with the analytical data and data quality. This may involve a discussion of uncertainty in the COPC selection process, the inclusion or exclusion of COPCs in the risk assessment on the basis of background concentrations, the uncertainty in COPC screening levels, and the omission of constituents for which health criteria are not available. The discussion will be based, in part, on the evaluation in the "Data Useability Worksheet" as suggested RAGS Part D (U.S. EPA, 1998).

### **5.2      Uncertainty in the Exposure Assessment**

This section will include a discussion of the following: assumptions related to current and future land use; the uncertainty in exposure point concentrations, for example, the use of maximum concentrations to estimate risks; uncertainty in the selection of potential receptors and exposure scenarios; and uncertainty in the selection of exposure parameters (RME vs. CTE). If predictive models are used in the risk estimation, the uncertainty associated with the model and modeling parameters will be evaluated.

### **5.3      Uncertainty in the Toxicity Assessment**

The uncertainties inherent in RfDs and CSFs and use of available criteria will be discussed. A discussion of the uncertainty in hazard assessment that deals with characterizing the nature and strength of the evidence of causation or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans, will be provided. This section will also discuss uncertainty in the dose-response evaluations for the COPCs that relates to the determination of a CSF for the carcinogenic assessment and derivation of an RfD or Reference Concentration (RfC) for the noncarcinogenic assessment. In addition, a discussion of the uncertainty in the toxicity of specific constituents, such as PAHs, arsenic, chromium, aluminum, iron, and copper, will be presented, if applicable.

### **5.4      Uncertainty in the Risk Characterization**

This section will discuss the uncertainty in risk characterization that results primarily from assumptions made regarding additivity/synergism of effects from exposure to multiple COPCs affecting different target organs across various exposure routes. The risk assessment will discuss the uncertainty inherent in summing risks for several substances across different exposure pathways. It should be noted that probabilistic risk assessment techniques may also be used to further define the uncertainty attached to the risk characterization results. However, the exposure assumptions (e.g., probability distributions) used

to prepare the probabilistic risk assessment will be reviewed with the regulatory reviewers before they are incorporated into the uncertainty section of the baseline risk assessment.



## SITE 17 - TABLE 1

**OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN  
SITE 7 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe:

Medium:

Exposure Medium:

Exposure Point:

CAS Number	Chemical	Minimum Concentration (1)	Minimum Qualifier	Maximum Concentration (1)	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening	Background Value (2)	Screening Toxicity Value (3)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for Contaminant Deletion or Selection (4)

1 Minimum/maximum detected concentration.

2 N/A - Refer to supporting information for background discussion.

Background values derived from statistical analysis. Follow Regional guidance and provide supporting information.

3 Provide reference for screening toxicity value.

4 Rationale Codes Selection Reason: Infrequent Detection but Associated Historically (HIST).

Frequent Detection (FD)

Toxicity Information Available (TXI)

Above Screening Levels (ASL)

Deletion Reason: Infrequent Detection (IFD)

Background Levels (BKG)

No Toxicity Information (NTX)

Essential Nutrient (NUT)

Below Screening Level (BSL)

Definitions: N/A = Not Applicable

SQL = Sample Quantitation Limit

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

MCL = Federal Maximum Contaminant Level

SMCL = Secondary Maximum Contaminant Level

J = Estimated Value

C = Carcinogenic

N = Non-Carcinogenic

**SITE 17 - TABLE 2**

**EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION  
 SITE 17 – PETTIBONE CREEK AND THE BOAT BASIN  
 NTC GREAT LAKES, ILLINOIS**

<b>Receptors</b>	<b>Exposure Routes</b>
Adolescent Recreational Users (7 to 16 Years) (current/future land use)	<ul style="list-style-type: none"> <li>• Sediment Dermal Contact</li> <li>• Sediment Ingestion</li> <li>• Surface Water Dermal Contact</li> <li>• Surface Water Ingestion</li> </ul>
Adult Recreational Users (current/future land use)	<ul style="list-style-type: none"> <li>• Sediment Dermal Contact</li> <li>• Sediment Ingestion</li> <li>• Surface Water Dermal Contact</li> <li>• Surface Water Ingestion</li> <li>• Fish Ingestion</li> </ul>

SITE 17 - TABLE 3

VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF ADOLESCENT RECREATIONAL USERS TO SURFACE WATER  
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS

Scenario Timeframe: Current/Future  
Medium: Surface Water  
Exposure Medium: Surface Water  
Exposure Point: Surface Water  
Receptor Population: Recreational User  
Receptor Age: Adolescent (7 to 16 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Ingestion	Csw	Chemical Concentration in Surface Water	mg/L	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Ingestion CDI <sup>(1)</sup> (mg/kg/day) = $\frac{C_{sw} \times CR \times ET \times EF \times EV \times ED}{BW \times AT}$
	CR	Contact Rate	L/hour	0.05	U.S. EPA, 1989	0.05	U.S. EPA, 1989	
	ET	Exposure Time	hours/event	4	Professional Judgement	2	Professional Judgement (1/2 the RME)	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	BW	Body Weight	kg	42	U.S. EPA, 1997	42	U.S. EPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, 1989	25,550	U.S. EPA, 1989	
Dermal	AT-N	Averaging Time (Non-Cancer)	days	3,650	U.S. EPA, 1989	3,650	U.S. EPA, 1989	Dermally Absorbed Dose = $\frac{DA_{event} \times EV \times EF \times ED \times A}{BW \times AT}$  DA <sub>event</sub> = Constants x K <sub>p</sub> x C <sub>w</sub> x t <sub>event</sub>
	Csw	Chemical Concentration in Surface Water	mg/L	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	
	A	Skin Surface Area Available for Contact	cm <sup>2</sup>	3,820	U.S. EPA, 1997	3,100	U.S. EPA, 1997	
	DA <sub>event</sub>	Absorbed Dose per Event	mg/cm <sup>2</sup> -event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	t <sub>event</sub>	Duration of Event	hour/event	4	Professional Judgement	2	Professional Judgement (1/2 the RME)	
	t*	Time to reach steady state	hour/event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	T	Lag Time	hour/event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	B	Bunge Model Constant	dimensionless	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	K <sub>p</sub>	Permeability Coefficient from Water	cm/hour	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	BW	Body Weight	kg	42	U.S. EPA, 1997	42	U.S. EPA, 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, 1989	25,550	U.S. EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	3,650	U.S. EPA, 1989	3,650	U.S. EPA, 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa, Office of Research and Development, August.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 17 - TABLE 4

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF ADULT RECREATIONAL USERS TO SURFACE WATER  
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Current/Future  
Medium: Surface Water  
Exposure Medium: Surface Water  
Exposure Point: Surface Water  
Receptor Population: Recreational User  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Ingestion	Csw	Chemical Concentration in Surface Water	mg/L	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Ingestion CDI <sup>(1)</sup> (mg/kg/day) = $C_{sw} \times CR \times ET \times EF \times EV \times ED$ BW x AT
	CR	Contact Rate	L/hour	0.05	U.S. EPA, 1989	0.05	U.S. EPA, 1989	
	ET	Exposure Time	hours/event	4	Professional Judgement	2	Professional Judgement (1/2 the RME)	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	24	EPA 1993. Assumed length of residence for adult living near the site.	7	EPA 1993. Assumed length of residence for adult living near the site.	
	BW	Body Weight	kg	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, 1989	25,550	U.S. EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	U.S. EPA, 1989	2,555	U.S. EPA, 1989	
Dermal	Csw	Chemical Concentration in Surface Water	mg/L	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Dermally Absorbed Dose = $DA_{event} \times EV \times EF \times ED \times A$ BW x AT
	A	Skin Surface Area Available for Contact	cm <sup>2</sup>	9,190	U.S. EPA 1997	7,770	U.S. EPA 1997	
	DA <sub>event</sub>	Absorbed Dose per Event	mg/cm <sup>2</sup> -event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	DA <sub>event</sub> = Constants x Kp x Cw x t <sub>event</sub>
	EV	Event Frequency	event/day	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	years	24	EPA 1993. Assumed length of residence for adult living near the site.	7	EPA 1993. Assumed length of residence for adult living near the site.	
	EF	Exposure Frequency	days/year	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	t <sub>event</sub>	Duration of Event	hour/event	4	Professional Judgement	2	Professional Judgement (1/2 the RME)	
	t*	Time to reach steady state	hour/event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	T	Lag Time	hour/event	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	B	Bunge Model Constant	dimensionless	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	Kp	Permeability Coefficient from Water	cm/hour	chemical-specific	U.S. EPA, 2000	chemical-specific	U.S. EPA, 2000	
	BW	Body Weight	kg	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, 1989	25,550	U.S. EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	8,760	U.S. EPA, 1989	2,555	U.S. EPA, 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 17 - TABLE 5

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF ADOLESCENT RECREATIONAL USERS TO SEDIMENT  
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Current / Future  
Medium: Sediment  
Exposure Medium: Sediment  
Exposure Point: Sediment  
Receptor Population: Recreational User  
Receptor Age: Adolescent (7 to 16 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Sediment	(mg/kg)	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ BW x AT
	IRs	Ingestion Rate of Sediment	(mg/day)	100	U.S. EPA 1993	50	U.S. EPA 1993	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	CF	Conversion Factor	(kg/mg)	1.0E-06	U.S. EPA 1989	1.0E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	42	U.S. EPA 1997	42	U.S. EPA 1997	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
Dermal	AT-N	Averaging Time (Noncancer)	(days)	3,650	U.S. EPA 1989	3,650	U.S. EPA 1989	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ BW x AT
	Cs	Chemical Concentration in Sediment	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.3	U.S. EPA 2000	0.04	U.S. EPA 2000	
	SA	Skin Surface Area	(cm <sup>2</sup> )	3,280	U.S. EPA 1997	3,100	U.S. EPA 1997	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000	chemical-specific	U.S. EPA 2000	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	ED	Exposure Duration	(years)	10	Adolescent, Age 7 - 16	10	Adolescent, Age 6 - 16	
	CF	Conversion Factor	(kg/mg)	1.0E-06	U.S. EPA 1989	1.0E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	42	U.S. EPA 1997	42	U.S. EPA 1997	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	3,650	U.S. EPA 1989	3,650	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. U.S. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997: Exposure Factors Handbook, U.S. EPA/600/P-95/002Fa/, Office of Research and Development, August.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 17 - TABLE 6

VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF ADULT RECREATIONAL USERS TO SEDIMENT  
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS

Scenario Timeframe: Current / Future  
Medium: Sediment  
Exposure Medium: Sediment  
Exposure Point: Sediment  
Receptor Population: Recreational User  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Sediment	(mg/kg)	95% UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times IRs \times CF \times FI \times EF \times ED$ BW x AT
	IRs	Ingestion Rate of Sediment	(mg/day)	100	U.S. EPA 1993	50	U.S. EPA 1993	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(years)	24	U.S. EPA 1993. Assumed length of residence for adult living near the site.	7	U.S. EPA 1993. Assumed length of residence for adult living near the site.	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	U.S. EPA 1989	2,555	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Sediment	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993	Chronic Daily Intake (CDI) (mg/kg-day) = $Cs \times SA \times CF \times ABS \times AF \times EF \times ED$ BW x AT
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.3	U.S. EPA 2000	0.04	U.S. EPA 2000	
	SA	Skin Surface Area	(cm <sup>2</sup> )	9,190	U.S. EPA 1997	7,770	U.S. EPA 1997	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000	chemical-specific	U.S. EPA 2000	
	EF	Exposure Frequency	(days/year)	52	Professional Judgement (2 days per week in warm weather months)	26	Professional Judgement (1/2 the RME)	
	ED	Exposure Duration	(years)	24	U.S. EPA 1993. Assumed length of residence for adult living near the site.	7	U.S. EPA 1993. Assumed length of residence for adult living near the site.	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	8,760	U.S. EPA 1989	2,555	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

U.S. EPA, 2000: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

SITE 17 - TABLE 7

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR  
EXPOSURE OF ADULT RECREATIONAL USERS BY INGESTION OF FISH  
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Current/Future  
Medium: Sediment  
Exposure Medium: Fish Tissue  
Exposure Point: Fish Tissue  
Receptor Population: Recreational Users  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CFish	Chemical Concentration in Fish	mg/kg	Calculated by multiplying 95% UCL for Sediment by BASF	U.S. EPA 1993	Calculated by multiplying 95% UCL for Sediment by BASF	U.S. EPA 1993	$\text{Intake (mg/kg/day)} = \frac{\text{CFish} \times \text{IR} \times \text{FI} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$
	IR	Ingestion Rate of fish	kg/meal	0.025	U.S. EPA, 1997	0.008	U.S. EPA, 1997	
	FI	Fraction ingested from source	unitless	0.25	Professional Judgement	0.25	Professional Judgement	
	EF	Exposure Frequency	meals/year	365	U.S. EPA 1997	365	U.S. EPA 1997	
	ED	Exposure Duration	years	30	U.S. EPA, 1993	9	U.S. EPA, 1993	
	BW	Body Weight	kg	70	U.S. EPA, 1989	70	U.S. EPA, 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, 1989	25,550	U.S. EPA, 1989	
	AT-N	Averaging Time (Non-Cancer)	days	10,950	U.S. EPA, 1989	3,285	U.S. EPA, 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, DC. May.

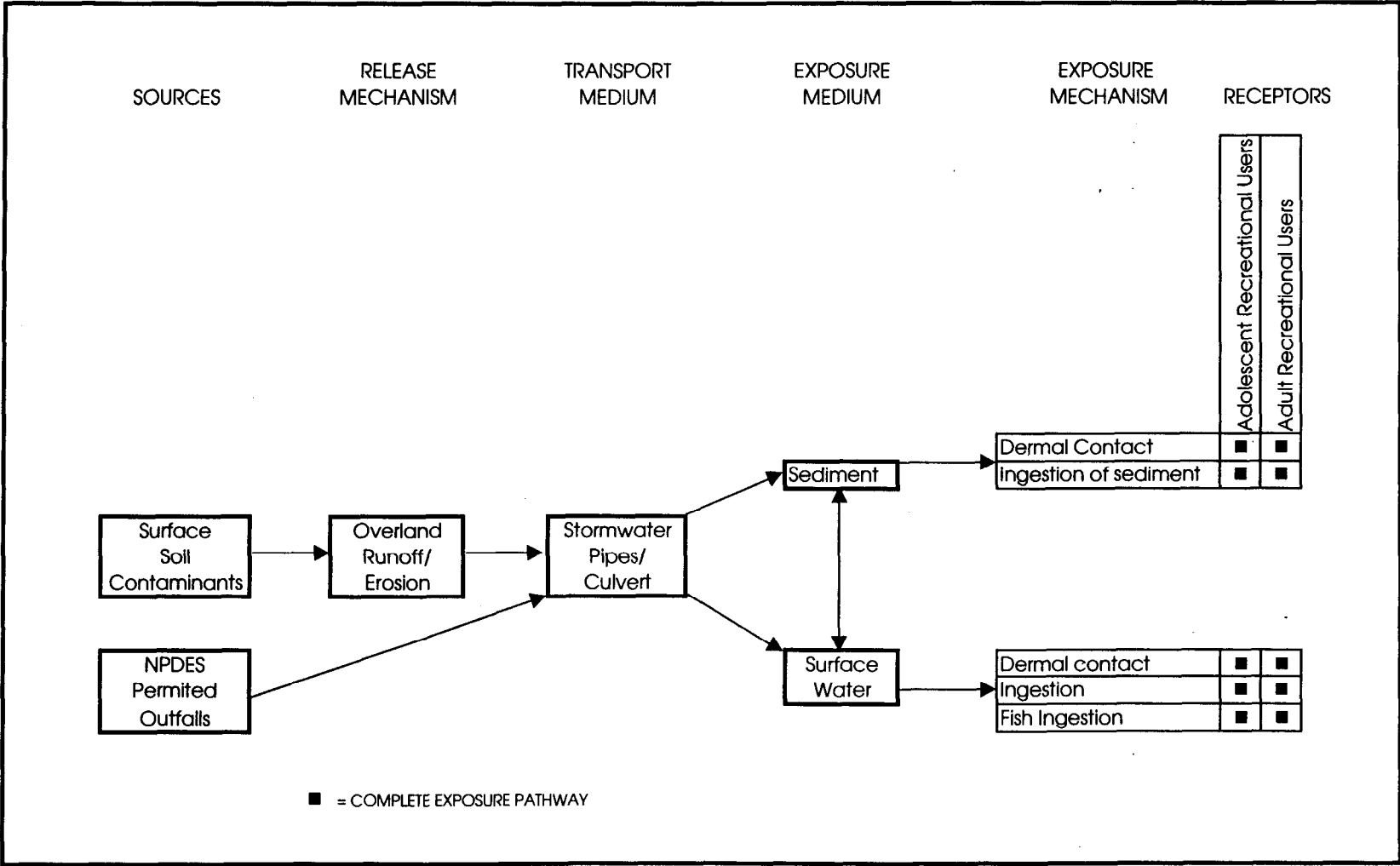
U.S. EPA, 1997: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

This page intentionally left blank.



SITE 17 - FIGURE 1

HUMAN HEALTH CONCEPTUAL SITE MODEL  
SITE 17 - PETTIBONE CREEK AND THE BOAT BASIN  
NTC GREAT LAKES, ILLINOIS



## REFERENCES

ASTM, 1997. Standard Guide for Risk-Based Corrective Action (RBCA), ASTM E 1739, American Society for Testing and Materials, West Conshohocken, Pennsylvania.

Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring, VanNostrand-Reinhold Company, New York, New York.

IEPA, 1996. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online March, 2001.

IEPA, 1999. Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, Part 302, Water Quality Standards.

IEPA, 2000. Tiered Approach for Evaluation and Remediation of Product Releases to Sediments, September.

Department of the Navy, 2001 Conducting Human Health Risk Assessments under the Environmental Restoration Program. Ser N453E/1U595168. Washington, D.C., February.

National Library of Medicine, 2001. TOXNET, Hazardous Substance Data Base (HSDB), accessed online at <http://toxnet.nlm.nih.gov/cgi/sis>.

U.S. Department of Energy, 2001. Risk Assessment Information System (RAIS), Office of Environmental Management, Oak Ridge Operations (ORO), accessed online at [http://risk.lsd.ornl.gov/rap\\_hp.shtml](http://risk.lsd.ornl.gov/rap_hp.shtml).

U.S. EPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A). EPA 540/1-89/002. Office of Emergency and Remedial Response, Washington, D.C., December.

U.S. EPA, 1991a. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03. Washington, D.C., March.

U.S. EPA, 1991b. Risk Assessment Guidance for Superfund: Volume 1 – Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals, Interim. Publication 9285.7-01B, Office of Emergency and Remedial Response, Washington, D.C., December.

U.S. EPA, 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. OSWER Publication No. 9285.7-081. Washington, D.C., May.

U.S. EPA, 1993a. Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C., May.

U.S. EPA, 1993b. Provisional Guidance for Quantitative Risk Assessment of Polynuclear Aromatic Hydrocarbons, EPA/600/R-93/089, Environmental Criteria and Assessment Office, Washington, D.C., July.

U.S. EPA, 1994a. Revised Interim Soil Lead for CERCLA Sites and RCRA Corrective Action Facilities. Directive 9355.4-12, Office of Solid Waste and Emergency Response, Washington, D.C., July.

U.S. EPA, 1994b. Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children, EPA/540/R-93/081, Office of Emergency and Remedial Response, Washington, D.C. February.

U.S. EPA, 1996a. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Solid Waste and Emergency Response. Washington, D.C., May.

U.S. EPA, 1996b. Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Lead Exposure in Soil. Technical Review Workgroup for Lead. December.

U.S. EPA, 1997a. Exposure Factors Handbook. EPA/600/P-95/002Fa. Office of Health and Environmental Assessment, Washington, D.C., August.

U.S. EPA, 1997b. The Lognormal Distribution in Environmental Applications. Technology Support Center Issue, EPA/600/R-97/006, Office of Solid Waste and Emergency Response, Washington, D.C., December.

U.S. EPA, 1997c. Health Effects Assessment Summary Tables (HEAST). July

U.S. EPA, 1998. Risk Assessment for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments. Publication 9285.7-01D, Washington, D.C., January.

U.S. EPA, 1999. National Recommended Water Quality Criteria, EPA 822-Z-99-001, Office of Water, Washington, D.C., April.

U.S. EPA, 2000a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance, Dermal Risk Assessment) Interim Guidance. Office of Emergency and Remedial Response, Washington, D.C.

U.S. EPA, 2000b. "Region 9 Preliminary Remediation Goals (PRGs)", EPA Region IX, 75 Hawthorne Street, San Francisco, California, 94105, November

U.S. EPA, 2000c. Risk-Based Concentration Table. EPA Region 3, 841 Chestnut Street, Philadelphia, Pennsylvania 19107, October.

U.S. EPA, 2000d. Drinking Water Standards and Health Advisories. EPA 822-B-00-001, Office of Water, Washington, D.C. Summer.

U.S. EPA, 2001. Integrated Risk Information System (IRIS), accessed online.

## **APPENDIX II**

### **ECOLOGICAL RISK ASSESSMENT WORK PLAN**

## **II.1 SITE 7 RTC SILK SCREENING SHOP**

## SITE 7 ECOLOGICAL RISK ASSESSMENT

### 1.0 INTRODUCTION

The goal of the Screening-Level Ecological Risk Assessment (SERA) is to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment through past site operations within the Site 7 (Building 1212) basin, at Naval Training Center (NTC) Great Lakes. The SERA will provide information to scientists and managers that will enable them to conclude either that ecological risks at the site are most likely negligible, or that further information is necessary to better evaluate potential ecological risks at the site. A phased approach to the SERA will be used that relies first on environmental chemistry data and field observations for the preliminary assessments. Biological sampling or testing may be conducted if further work is needed. The SERA methodology used at NTC Great Lakes will follow the guidance presented in the Final Guidelines for Ecological Risk Assessment (USEPA, 1998a) and the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, June 1997).

This SERA will consist of the Steps 1, 2 of eight steps required by the Environmental Protection Agency (USEPA) guidance (USEPA, 1997a and 1998) and the Navy Policy for Conducting Ecological Risk Assessments. Figure 1-1 presents the Navy's Ecological Risk Assessment Tiered Approach. The first two steps are the screening-level assessment. Step 3a is the first step of the BERA and further refines the list of contaminants of potential concern (COPCs) that were retained from the SERA and determines if Steps 3b through 7 of the BERA are necessary. Finally, Step 8, Risk Management, is incorporated throughout the ERA process, in cooperation with the Region 5 Biological Technical Assistance Group (BTAG).

In the first phase of the ERA process (Steps 1 and 2), conservative exposure estimates are made for grouped or individual ecological receptors, and these exposures are compared to screening-levels and threshold toxicity values. The SERA includes the following considerations:

- Screening-level problem formulation
- Screening-level ecological effects evaluation
- Screening-level exposure estimate
- Screening-level risk calculation

These sections are discussed in detail throughout the QAPP and this appendix.

## **1.1 SCREENING-LEVEL PROBLEM FORMULATION**

The screening-level problem formulation for an ecological risk assessment includes identification of potential receptor groups, chemicals of potential concern (COPCs), and the mechanisms for fate/transport and toxicity. Determination of the complete exposure pathways that exist on a site is done at this stage to facilitate receptor selection. As part of receptor identification, site habitats and potential ecological receptors are described.

### **1.1.1 Environmental Setting**

Site 7 consists of Building 1212 and the surrounding area, which is currently paved. Building 1212 is bounded to the east by Ohio Street, which also is paved. The land east of Ohio Street is heavily vegetated with shrubs and trees. The vegetated area slopes up several feet within a few feet of Ohio Street, and then slopes up further when it reaches the railroad tracks that are located approximately one hundred feet east of Ohio Street. A drainage ditch is located east of Sheridan Road and several hundred feet east of Site 7. The drainage ditch, which flows through the golf course and eventually discharges to Pettibone Creek, which is located approximately 3000 feet east of Site 7.

Based on the habitat at the site, there are no significant ecological receptors at the site. There are some ecological receptors east of the site in the vegetated area (e.g., small mammals and birds). However, as discussed below, chemicals from Site 7 are not expected to have migrated to this area.

### **1.1.2 Contaminants Ecotoxicity and Fate and Transport**

Based on the historical data from the site, several classes of chemicals have the potential to be present at the site. These include metals, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). The following sections present a brief discussion regarding the toxicity, potential food chain and trophic transfer, and fate and transport properties of each class of contaminants.

#### **1.1.2.1 Physical and Chemical Characteristics**

Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include bioconcentration factors (BCFs), organic carbon partition coefficients and octanol water partition coefficients. The following paragraphs discuss the significance of each factor.



Bioconcentration factors measure the tendency for a chemical to partition from the water column or sediment and concentrate in aquatic organisms. Bioconcentration factors are important for ecological receptors because chemicals with high BCFs could accumulate in lower-order species and subsequently accumulate to toxic levels in species higher up the food chain. The BCF is the concentration of the chemical in the organism at equilibrium divided by the concentration of the chemical in the water.

The organic carbon partition coefficient ( $K_{oc}$ ) measures the tendency for a chemical to partition between water and soil or sediment particles that contain organic carbon. This coefficient is important in the ecological environment because it determines how strongly an organic chemical will bind to the organic carbon in soil or sediment.

The octanol/water partition coefficient ( $K_{ow}$ ) is the ratio of a chemical concentration in octanol divided by the concentration in water. The octanol/water partition coefficient has been shown to correlate well with bioconcentration factors in aquatic organisms and with adsorption to soil or sediment.

The BCFs,  $K_{oc}$ s, and  $K_{ow}$ s for the contaminants detected in the groundwater will be included in the SERA.

#### **1.1.2.2 Metals**

Many metals occur naturally at various concentrations in the surface water, sediment, and/or soil due primarily to chemical weathering of rocks and fallout from volcanoes. Most metals are toxic to aquatic (i.e., fish, invertebrates) and terrestrial (i.e., plants, invertebrates, vertebrates) ecological receptors above certain concentrations, with some metals being more toxic at lower concentrations than others. Also, different chemical forms of the metals may be more toxic than others. For example, hexavalent chromium is typically more toxic than trivalent chromium, and methylmercury is more toxic than inorganic mercury. In addition, the toxicity of several metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) to aquatic receptors in freshwater systems decreases with increasing water hardness.

Only a portion of the total bulk concentration of metals in soils is available to ecological receptors. The bioavailability of the metals, however, is not known because there are other factors that influence the uptake and accumulation of trace elements by plants such as pH, Eh, clay content, organic matter content, cation exchange capacity, nutrient balance, concentration of other trace elements in soil, soil moisture, and temperature (Tarradellas et al., 1996).

Of the 29 elements essential for plant growth, seven are micronutrients, including copper, iron, manganese, and zinc (Tarradellas et al., 1996). Also, the following metals may stimulate plant growth but

are only essential for some plant species: aluminum, cobalt, nickel, sodium, selenium, and vanadium (Tarradellas et al., 1996). Finally, some elements such as lead, cadmium, and mercury are toxic elements with no known function in plant metabolism (Tarradellas et al., 1996).

Many of the factors that influence plant uptake will influence the bioavailability of metals to invertebrates in sediment. One way to estimate the bioavailable portion of certain divalent metals (cadmium, copper, lead, nickel, and zinc) in sediment is to measure the amount of acid volatile sulfides (AVS) and simultaneously extracted metals (SEM) in a sediment sample. If the molar concentration of AVS is higher than the molar concentration of SEM, then the SEM metals are expected to be unavailable to aquatic invertebrates and, therefore, nontoxic. AVS plays little or no role in determining interstitial water concentrations of metals in aerobic systems or those with low productivity (i.e., where the absence of organic carbon limits sulfate reduction) (Ankley et al., 1996), or when ingestion of sediments is the primary exposure route (Lee et al., 2000).

#### **1.1.2.3 Semivolatile Organic Compounds**

The most common semivolatile organic compounds that are found at naval facilities include polynuclear aromatic hydrocarbons (PAHs) and phthalates. PAHs are a diverse group of compounds consisting of two or more substituted and unsubstituted polycyclic aromatic rings formed by the incomplete combustion of carbonaceous materials. PAHs are ubiquitous in the modern environment and commonly are constituents of coal tar, soot, vehicle exhaust, cigarette smoke, certain petroleum products, road tar, mineral oils, creosote, and many cooked foods. PAHs also are released to the environment through natural sources such as volcanoes and forest fires.

PAHs are transferred from surface water by volatilization and sorption to settling particles. The compounds are transformed in surface water by photooxidation, chemical oxidation, and microbial metabolism (ATSDR, 1989a). In soil and sediments, microbial metabolism is the major process for degradation of PAHs (ATSDR, 1989a). Although PAHs accumulate in terrestrial and aquatic plants, many organisms are able to metabolize and eliminate these compounds. Vertebrates can readily metabolize PAHs, but lower forms (insects and worms) cannot metabolize PAHs as quickly. Food chain uptake does not appear to be a major exposure source to PAHs for aquatic animals (ATSDR, 1989a).

PAHs vary substantially in their toxicity to aquatic organisms. In general, toxicity increases as molecular weight increases, with the exception of some high molecular weight PAHs that have low acute toxicity. Most species of aquatic organisms rapidly accumulate PAHs that occur at low concentrations in the ambient medium. However, uptake of PAHs is highly species-specific, it is higher in algae, mollusks, and other species that are incapable of metabolizing PAHs (Eisler, 1987). The ability of fish to metabolize

PAHs may explain why benzo(a)pyrene is frequently not detected or is found at only very low levels in fish from environments heavily contaminated with PAHs (ATSDR, 1989a).

Phthalates are compounds that are used in production of plastics (ATSDR, 1993). Most phthalates are expected to sorb to soil or sediment particles after their release because of their high Log  $K_{oc}$  values (Howard, 1989). Some phthalates may bioconcentrate in aquatic organisms [Spectrum Laboratories, 1999; Howard, 1989; ATSDR, 1989a].

#### **1.1.2.4 Volatile Organic Compounds**

VOCs are usually very mobile in the environment because they are poorly adsorbed to soil or sediment particles. Also, because they are very volatile, they typically are only detected in surface waters and surface soils at low concentrations.

Most VOCs have very little potential to bioaccumulate in ecological receptors; therefore, biomagnification through the food chain does not appear to be significant. VOCs are not expected to magnify in plants and are typically toxic to ecological receptors only at relatively high concentrations.

#### **1.1.3 Potential Exposure Pathways**

Based on the historical site operations, the primary source of contaminants is the soil. From the soil, the contaminants may migrate to groundwater. Contaminants from the site may have historically drained along Ohio Street and into the storm drains adjacent to the road. However, because waste water has not been discharged from the site in over 15 years, it is unlikely that any chemicals from the site would remain in the storm drain or the drainage ditch. The following paragraphs discuss each of the potential exposure pathways. Figure 1-2 presents the conceptual site model.

##### **1.1.3.1 Ground Water**

Groundwater at Site 7 is expected to be relatively shallow, based on the data from other nearby sites. Currently, no discharge points for the groundwater potentially contaminated with site-related contaminants have been identified, and the direction of groundwater flow has not been determined. However, groundwater may discharge to the drainage ditch adjacent to Sheridan Road either directly or via the storm water pipe. It is possible that the groundwater will eventually discharge to Pettibone Creek, but it would be mixed with non-Site 7 groundwater and significantly diluted by time it discharges to the creek.

In summary, ecological receptors are not directly exposed to groundwater at the site. Receptors could be exposed to groundwater if it discharges to a drainage ditch or Pettibone Creek

#### **1.1.3.2 Surface Water**

There are no surface water bodies immediately adjacent to Site 7. Because the site is paved and the area east of the site slopes up, it is unlikely that chemicals entered the tributary to Pettibone Creek via overland flow. However, as discussed above, it is possible that groundwater associated with Site 7 discharges to the drainage ditch leading to Pettibone Creek, or discharges directly to Pettibone Creek. The ditch and Pettibone Creek may support healthy fish and/or benthic macroinvertebrate communities. These receptors could be exposed to the water by direct contact and incidental ingestion of water.

#### **1.1.3.3 Surface Soil**

Currently, and for the foreseeable future, the site is and will remain paved. The only exposed soil near the site is the vegetated land located east of Ohio Street. Because the land slope up immediately east of Ohio Street, chemicals from the site would only have been deposited in a small (less than a few feet wide) area. Although invertebrates and plants could be exposed to chemical in this area, the small size of the potentially contaminated area would not be ecologically significant. Therefore, this exposure pathway will not be evaluated in the SERA.

#### **1.1.3.4 Air**

The inhalation pathway will not be evaluated because air concentrations are expected to be minimal because the majority of the site is paved or vegetated (east of the site). Also, inhalation pathways typically are not evaluated in SERAs because of the uncertainty in exposures and effects concentrations.

### **1.1.4 Endpoints**

#### **1.1.4.1 Assessment Endpoints**

Assessment endpoints are an explicit expression of the environmental value that is to be protected (USEPA 1997a). The selection of these endpoints is based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to enter receptors.

There is little undeveloped habitat at Site 7. Therefore, the only assessment endpoints are protecting fish and benthic invertebrates in the drainage ditch and Pettibone Creek (via discharge of groundwater) from adverse effects of contaminants on their growth, survival, and reproduction. The following paragraph describes why the assessment endpoints were selected for this SERA.

*Benthic Macroinvertebrates and Fish:* Benthic macroinvertebrates and fish serve as a food source for higher trophic organisms (i.e., fish, amphibians, birds, mammals), and are likely to be present in the drainage ditch and/or Pettibone Creek. They may be at risk from direct exposure to contaminants in the surface water. Also, benthic invertebrates and fish can accumulate contaminants that may be transferred to the higher trophic organisms.

#### **1.1.4.2 Measurement Endpoints**

Measurement endpoints are estimates of biological impacts (e.g., mortality, growth and reproduction) that are used to evaluate the assessment endpoints. The following measurement endpoint will be used to evaluate the assessment endpoints in this SERA, where applicable.

Surface water screening values – Mortality and other adverse effects to aquatic organisms (i.e., growth, feeding rates, behavioral changes) will be evaluated by comparing the measured concentrations (maxima and averages) of chemicals in the groundwater to surface water screening values designed to be protective of ecological receptors. This screening is conservative, because surface water is several hundred feet east of the site and it is likely that groundwater related to the site would be very diluted by the time it discharges to the drainage ditch or Pettibone Creek.

#### **1.1.4.3 Selection of Receptor Species**

Many receptors in the aquatic environment are adequately described in general categories such as fish and sediment-dwelling (benthic) invertebrates. This is due to the general nature of the threshold values, effects values, or water quality criteria that are typically used to characterize risk for such organisms. Therefore, specific benthic invertebrates and fish species will not be selected as indicator receptor species.

#### **1.1.5 Ecological Effects Evaluation**

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicity study, it may also include descriptions of apparent effects seen during the site

visit. Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as surface water for aquatic organisms or soil for soil invertebrates.

As the first step in the ecological effects evaluation, COPCs will be selected by comparing the contaminant concentrations in the groundwater samples to screening values developed for surface water. The COPCs will be selected by comparing the maximum contaminant concentrations to screening values presented in Section A. Calcium, magnesium, potassium, and sodium will not be retained as COPCs in any medium because of their relatively low toxicity to ecological receptors, and their high natural variability. Contaminants without screening values will be retained as COPCs but they may only be evaluated qualitatively.

If a chemical is non-detected at the reporting limit in all of the samples in a particular media, and the reporting limit exceeds the screening level, the chemical will not be quantitatively carried through the risk assessment as a COPC. However, the chemical, its reporting limit, and the screening level will be summarized in a table and qualitatively discussed in the uncertainty analysis section. If a chemical is detected in at least one sample at levels greater than the reporting limit, one-half of the reporting limit will be substituted for the non-detects for calculating summary statistics (e.g., mean concentrations).

The surface water screening values (SWSVs) that will be used to evaluate the quality of the surface water were compiled from several different sources. The following bulleted list presents the order in which the sources were used and the paragraphs following the bulleted list describe the sources and why they were selected:

- IEPA Water Quality Standards (WQS) (IEPA, 1999)
- IEPA Water Quality Criteria (WQC) (IEPA, 2000)
- USEPA Recommended Water Quality Criteria (WQC) (USEPA, 1999)
- USEPA Ecotox Thresholds (USEPA, 1996)
- Oak Ridge National Laboratory Surface Water Benchmarks (Suter and TSAO, 1996)

The IEPA WQS are the concentrations of toxic substances that will not result in acute or chronic toxicity to aquatic life. Most of the metals WQS will be based on dissolved metals in accordance with the Illinois WQS (IEPA, 1999). Also note that the values from Subpart E of the regulations will be used because the drainage ditch and Pettibone Creek are located within the Lake Michigan Basin. IEPA has also developed WQC for several chemicals, which are used to evaluate the quality of surface water bodies

(IEPA, 2000). These values were selected first because they are specific to Illinois and are enforceable standards.

The USEPA Recommended WQC were developed by USEPA to provide states with guidance for developing their own criteria (USEPA, 1999). These values are set to protect the majority of aquatic organisms from adverse impacts from contaminants in the surface water. These values were selected next because they are based on USEPA guidance.

The Ecotox Thresholds document was prepared by USEPA to provide benchmark screening values in the first step of a baseline risk assessment (USEPA, 1996). The surface water Ecotox Thresholds that were based on Suter and Mabrey, (1994) will not be used in this SERA because they have since been updated in Suter and Tsao (1996). These updated values will be used for the Ecotox Thresholds that were based on the Suter and Mabrey (1994) data. The Suter and Tsao (1996) benchmarks were calculated using Tier II methodology as described in the USEPA's Proposed Water Quality Guidance for the Great Lakes System (USEPA, 1993). Tier II values are developed so that aquatic benchmarks could be established with fewer data than are required for the USEPA AWQC. These values were used last because most of them are not regulatory in nature. However, they are commonly used as screening values in ecological risk assessments.

#### 1.1.6 Ecological Risk Characterization

The risk characterization is the final phase of a risk assessment that compares the exposure to the ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a contaminant will be evaluated. An Ecological Effects Quotient (EEQ) approach will be used to characterize the risk to terrestrial receptors. This approach characterizes the potential effects by comparing exposure concentration with the effects data. An EEQ of greater than "1.0" is considered to indicate a potential risk. The EEQ is not an expression of probability, and the meaning of values greater than 1.0 must be interpreted in light of uncertainties in risk management.

An EEQ for the aquatic receptors will be calculated as follows:

$$EEQ = \frac{C_{gw}}{SWSL}$$

Where: EEQ = Hazard Quotient, (unitless)

$C_{gw}$  = Contaminant concentration in groundwater, ( $\mu\text{g/L}$ )

SWSL = Surface Water Screening Level, ( $\mu\text{g/L}$ )

## 1.2 STEP 3A – REFINEMENT OF COPCS

Step 3a refines the list of COPCs from the SERA using less conservative benchmarks and more site-specific exposure assumptions (where available) to more realistically estimate potential risks to ecological receptors (i.e., plants, invertebrates, and aquatic receptors). For example, both maximum and average media concentrations will be compared to the benchmark values because the average concentration is a more realistic estimation of average exposure. Also, the evaluation will compare the groundwater concentrations to acute criteria, and criteria that may be more site-specific. For example, some of the water quality screening values are based on food chain transfer to protect piscivorous wildlife. However, because piscivorous wildlife are not considered an endpoint for this site, criteria based on protection of aquatic organisms will be used. This evaluation also may include (but is not necessarily limited to) a consideration of the following topics:

- Magnitude of criterion exceedence: Although risks may not relate directly to the magnitude of a criterion exceedence, the magnitude may be one factor used in a weight-of-evidence approach to determine the need for further site evaluation.
- Frequency of chemical detection: A chemical that is detected at a low frequency typically will be of less concern than a chemical detected at higher frequency provided that toxicity and concentrations of the constituents are similar. All else being equal, chemicals detected frequently will be given greater consideration than those detected relatively infrequently.
- Contaminant bioavailability: Many contaminants (especially metals) are present in the environment in forms that are typically not bioavailable and the limited bioavailability will be considered when evaluating the exposures of receptors to site contaminants.
- Habitat: Although exceedences of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat will be used qualitatively when considering the site for additional evaluation.

## 1.3 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section presents some of the uncertainties associated with ecological risk assessments.



### **1.3.1 Measurement and Assessment Endpoints**

Measurement endpoints are used to evaluate the assessment endpoints that are selected for the SERA. For this SERA, the measurement endpoints are not the same as the assessment endpoints. For example, impacts to fish from chemicals in the groundwater are not assessed directly by conducting toxicity tests. Rather, potential impacts are predicted by measuring the groundwater concentrations and comparing the results to water quality criteria.

### **1.3.2 Exposure Characterization**

There is uncertainty in the chemical data that are collected at the site. Measured levels of chemicals are only estimates of the true site chemical concentrations. For samples that are deliberately biased toward known or suspected high concentrations, predicted doses probably will be higher than actual doses.

### **1.3.3 Ecological Effects Data**

There is uncertainty in the ecological toxicity value comparison. The water quality criteria developed by USEPA in theory protects 95 percent of the exposed species. Therefore, some sensitive species may be present at the site that would not be protected by the use of these criteria. There also may be situations where the surface water screening levels (SWSLs) are over-predictive of risk if the sensitive species used to develop the criteria do not inhabit the site. Finally, with the exception of hardness for a few metals, the SWSLs do not account for site-specific factors, such as TOC or pH, that may affect toxicity.

The toxicity of chemical mixtures is not well understood. The toxicity information used in the ERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals because of synergistic or antagonistic effects.

Finally, toxicological data for a few of the COPCs are limited or do not exist. Therefore, there is uncertainty in any conclusions involving the potential impacts to ecological receptors from these constituents.

### **1.3.4 Risk Characterization**

Risks are projected if an EEQ is greater than or equal to unity regardless of the magnitude of the EEQ. Although the relationship between the magnitude of an EEQ and toxicity is not necessarily linear, the magnitude of an EEQ can be used as rough approximation of the extent of potential risks, especially if there

is sufficient confidence in the guideline used. Finally, there is uncertainty in how the predicted risks to individuals at the site translate into risk to the population in the area as a whole.

## **REFERENCES**

Agency for Toxic Substances and Disease Registry (ATSDR). 1989a. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Public Health Service. Atlanta, Georgia. October.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Toxicological Profile for Di(2-ethylhexyl)phthalate. U.S. Public Health Service, as found in Lakes Environmental Toxic Factsheet web site (<http://www.lakes-environmental.com>).

Ankley, Gerald T., D.M. Di Toro, D.J. Hansen, and W.J. Berry. 1995. Technical Basis and Proposal for Deriving Sediment Quality Criteria for Metals. *Environmental Toxicology and Chemistry*. Vol. 15(12), pp. 2056-2066.

DON (Department of the Navy). 1999. Navy Policy For Conducting Ecological Risk Assessments. Memo from Chief of Naval Operations to Commander, Naval Facilities Engineering Command, 05 April 1999. Department of the Navy, Washington, DC.

Eisler, Ronald. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. US Department of Interior - Fish and Wildlife Service. Biological Report 85 (1.11). May

Howard, Philip, ed. 1989. Handbook and Environmental Fate and Exposure Data for Organic Chemicals, Volume I – Large Production and Priority Pollutants. Lewis Publishers, Inc.

IEPA (Illinois Environmental Protection Agency), 2000a. Listing of Derived Water Quality Criteria pursuant to 35 Ill. Adm. Code 302, Subpart F. June 9.

IEPA (Illinois Environmental Protection Agency), 2000. Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediments. Draft, Update 2. Office of Chemical Safety. September 21.

IEPA (Illinois Environmental Protection Agency), 1999. Title 35: Environmental Protection Subtitle C: Water Pollution Chapter I: Pollution Control Board Part 302 Water Quality Standards. Effective August 26.

Lee, Byeong-Gweon, Sarah B. Griscom, Jung-Suk Lee, Heesun J. Choi, Chul-Hwan Koh, Samuel N. Lucoma, and Nicholas S. Fisher. 2000. Influences of Dietary Uptake and Reactive Sulfides on Metal Bioavailability from Aquatic Sediments. *Science*, Volume 287, pp. 282-284. January 14.

Spectrum Laboratories. 1999. Chemical Fact Sheets (<http://www.speclab.com>).

Suter, G.W. II. and J.B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1994 Revision. Environmental Sciences Division, Oak Ridge National Laboratory.

Suter, G.W. II. and C.L. Tsao. 1996. Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1996 Revision. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-96/R2.

Tarradellas, J., G. Bitton, and D. Rossel, Soil Ecotoxicology. CRC Lewis Publishes. 1997. Chapter 6.

USEPA (U.S. Environmental Protection Agency), 1993. Water Quality Guidance for the Great Lakes System and Correction: Proposed Rules. Federal Register. 58(72) 20802-21047.

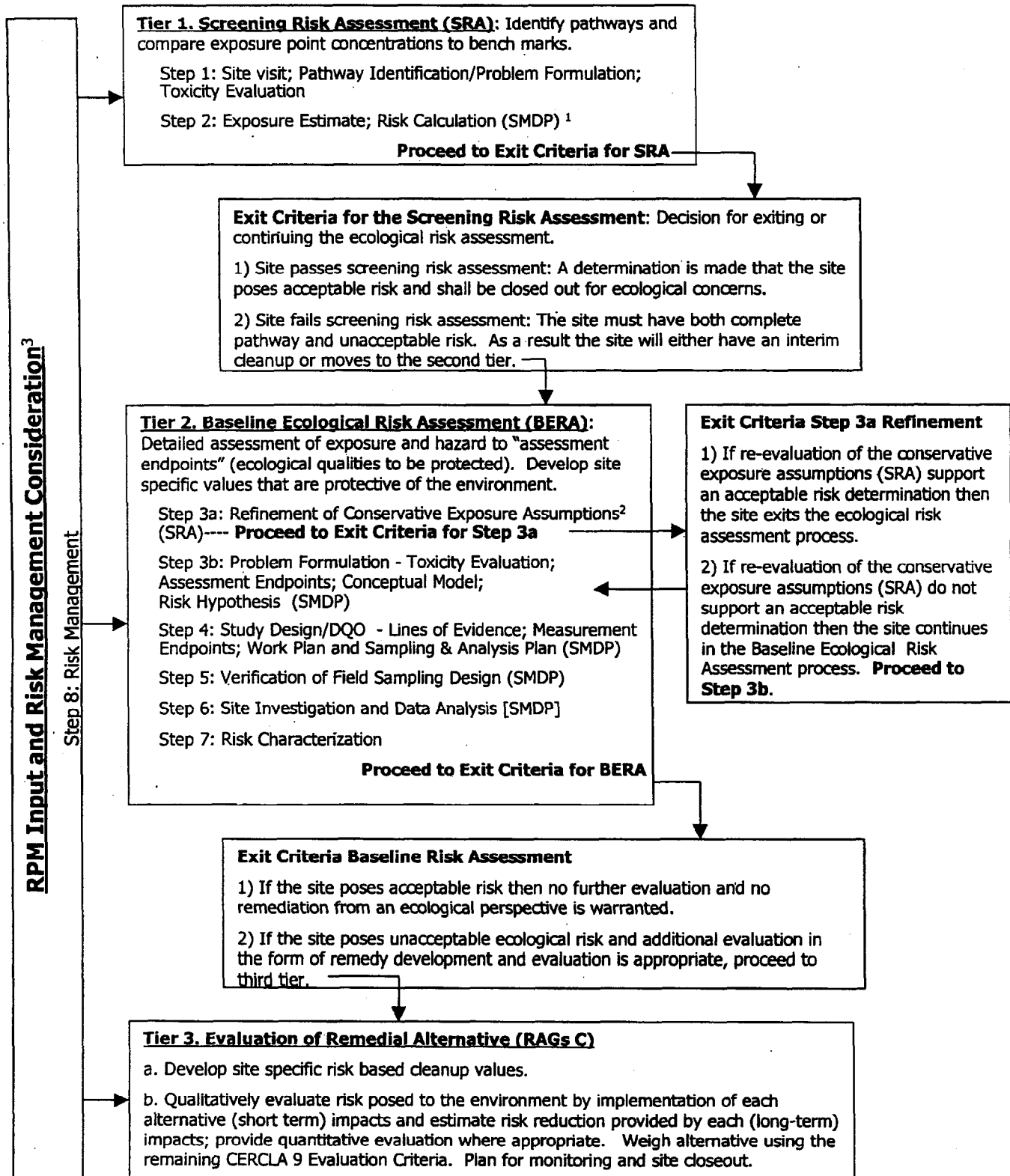
USEPA (U.S. Environmental Protection Agency), 1996. ECO Update, Ecotox Thresholds. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Intermittent Bulletin, Volume 3, Number 2. EPA540/F-95/038. January.

USEPA (U.S. Environmental Protection Agency), 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Environmental Response Team. June 5.

USEPA (U.S. Environmental Protection Agency), 1998. Final Guidelines for Ecological Risk Assessment. Effective April 30.

USEPA (U.S. Environmental Protection Agency), 1999. National Recommended Water Quality Criteria-Correction. Office of Water. EPA 822-Z-99-001. April.

# Navy Ecological Risk Assessment Tiered Approach



Notes: 1) See EPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).

2) Refinement includes but is not limited to background, bioavailability, detection frequency. Etc.

3) Risk Management is incorporated throughout the tiered approach.

**FIGURE 1-1**

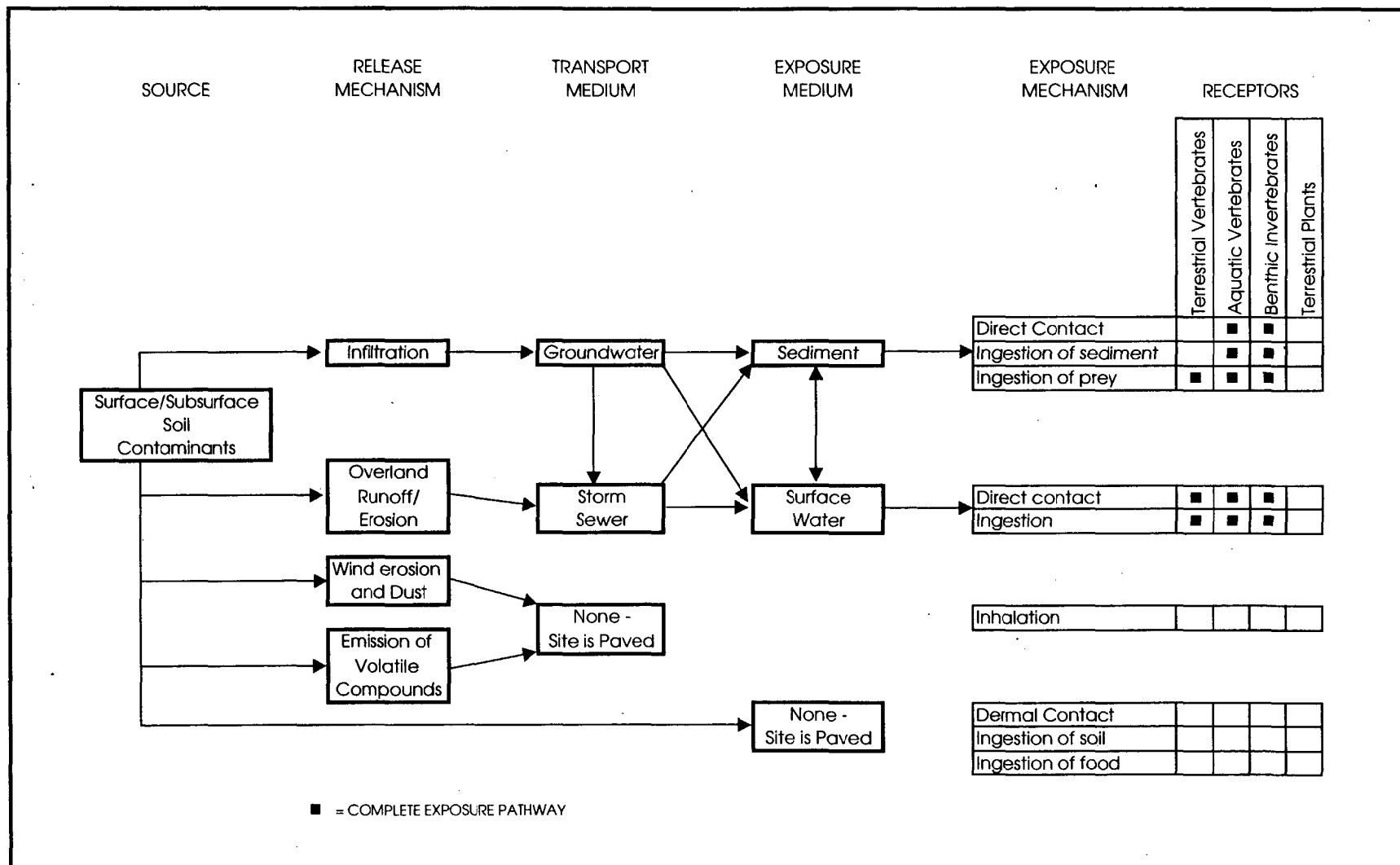


FIGURE 1-2

SITE 7  
ECOLOGICAL CONCEPTUAL SITE MODEL  
NTC GREAT LAKES, ILLINOIS

## **II.2 SITE 17 PETTIBONE CREEK AND BOAT BASIN**

## SITE 17 ECOLOGICAL RISK ASSESSMENT

### 1.0 INTRODUCTION

The goal of the Screening-Level Ecological Risk Assessment (Screening-Level ERA) is to determine whether adverse ecological impacts are present as a result of exposure to chemicals released to the environment through past site operations related to Site 17 (Pettibone Creek and the Boat Basin) basin, at Naval Training Center (NTC) Great Lakes. Note, however, that upstream industrial sources (not related to Navy activities) have contributed significant amounts of contaminants to Pettibone Creek and the Boat Basin. The Screening-Level ERA will provide information to scientists and managers that will enable them to conclude either that ecological risks at the site are most likely negligible, or that further information is necessary to better evaluate potential ecological risks at the site. A phased approach to the Screening-Level ERA will be used that relies first on environmental chemistry data and field observations for the preliminary assessments. Biological sampling or testing may be conducted if further work is needed. The Screening-Level ERA methodology used at NTC Great Lakes will follow the guidance presented in the Final Guidelines for Ecological Risk Assessment (U.S. EPA, 1998), the Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (U.S. EPA, June 1997a), and the Navy Policy for Conducting Ecological Risk Assessments (DON, 1999).

This Screening-Level ERA will consist of the Steps 1 and 2 of eight steps required by the Environmental Protection Agency (U.S. EPA) guidance (U.S. EPA, 1997a and 1998) and the Navy Policy for Conducting Ecological Risk Assessments. Figure 1-1 presents the Navy's Ecological Risk Assessment Tiered Approach. The first two steps are the screening-level assessment. Step 3a is the first step of the BERA and further refines the list of contaminants of potential concern (COPCs) that were retained from the Screening-Level ERA and determines if Steps 3b through 7 of the BERA are necessary. Finally, Step 8, Risk Management, is incorporated throughout the ERA process, in cooperation with the Region 5 Biological Technical Assistance Group (BTAG).

In the first phase of the ERA process (Steps 1 and 2), conservative exposure estimates are made for grouped or individual ecological receptors, and these exposures are compared to screening-levels and threshold toxicity values. The Screening-Level ERA includes the following considerations:

- Screening-level problem formulation
- Screening-level ecological effects evaluation



- Screening-level exposure estimate
- Screening-level risk calculation

These sections are discussed in detail throughout the QAPP and this appendix.

## **1.1 SCREENING-LEVEL PROBLEM FORMULATION**

The screening-level problem formulation for an ERA includes identification of potential receptor groups, chemicals of potential concern (COPCs), and the mechanisms for fate/transport and toxicity. Determination of the complete exposure pathways that exist on a site is done at this stage to facilitate receptor selection. As part of receptor identification, site habitats and potential ecological receptors are described.

### **1.1.1 Environmental Setting**

Pettibone Creek originates in North Chicago and enters the base at the northwest corner of NTC Great Lakes, meandering through Main Side and terminating into Lake Michigan. The north branch of Pettibone Creek begins outside of the Main Installation in an urbanized area zoned for light industry and is the discharge point for storm sewers within the City of North Chicago. The south branch originates in a residential area south of the Department of Veteran's Affairs Hospital, and flows to the east and then to the north through a private golf course before entering the Main Installation site. A 2.6-acre (1.1-ha) boat basin was created at the mouth of Pettibone Creek. Pettibone Creek flows through a ravine (named Pettibone Creek Ravine) that ranges from approximately 50 to 100 feet with 30 to 70-degree slopes. Slope and bluff substrates are in various stages of instability due in part to uncontrolled storm run-off and improper repair and maintenance techniques.

Most of the native forest areas have been cleared for development with the remaining native vegetation restricted to the lake bluffs, ravine slopes, and creek bottoms. This combined with additional man-made disturbances has allowed invasive plants to dominate much of the landscape.

According to the Restoration and Maintenance Plan for the Pettibone Creek Ravine, canopy dominants include sugar maple (*Acer saccharum*) and cottonwood (*Populus deltoides*). Northern red oak (*Quercus rubra*), American elm (*Ulmus americana*), and boxelder (*Acer negundo*) are significant subordinants. Sugar maple and boxelder dominate the subcanopy. The shrub layer is dominated by saplings of boxelder, sugar maple, black cherry (*Prunus serotina*), and American elm, as well as dogwood (*Cornus florida*), bush honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*) and eastern black current

(*Ribes americanum*) (NTC, 2000). Dominance in the herbaceous layer varies from place to place. Dominant species include garlic mustard (*Alliaria petiolata*), bedstraw (*Galium aparine*), wild leek (*Allium tricoccum*), trout lilies (*Erythronium albidum* and *americanum*), wild onion (*Allium sp.*), hispid buttercup (*Ranunculus hispidus*), and false Solomon's seal (*Smilacina racemosa*). Garlic mustard, bedstraw, multiflora rose, bush honeysuckle, teasel (*Dipsacus sylvestris*), and burdock (*Arctium minus*) are the most obvious non-native species, and each of these can, at times, be invasive (NTC, 2000).

Pettibone Creek provides potential habitat for fish, as do the Inner and Outer Harbors of the Main Installation. However, recent faunal surveys have not documented any significant fish populations within Pettibone Creek, although a few individual fish are reported well upstream from the mouth of the creek. A 1989 investigation of Pettibone Creek found low species diversity in the indigenous fish (U.S. Navy, 1990). Creek chubs (*Semotilus atromaculatus*), fathead minnows (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), and white suckers (*Catostomus commersoni*) were the dominant species in this community. NTC Great Lakes personnel have observed salmon congregating upstream from the mouth of Pettibone Creek (U.S. Navy, 1990). The reported salmon are most likely transient individuals and not part of permanent or self-sustaining populations of salmon in the creek.

Recent faunal surveys of the Main Installation have not documented the presence of amphibians or reptiles within Pettibone Ravine, the bluffs, or along the beaches, although potential habitat for these species is present.

Recent bird surveys documented 34 species of breeding birds and 100 species of migratory birds within the Main Installation (U.S. Navy, 1995 and 2000). Some of the breeding birds included in the survey are the belted kingfisher (*Ceryle alcyon*), downy woodpecker (*Picoides pubescens*), red-winged blackbird (*Agelaius phoeniceus*), and the cooper's hawk (*Accipiter cooperii*). The greatest concentration and diversity of species are found in Pettibone Ravine and along the bluffs and beach areas where human impacts are least.

Mammals likely or known to occur on the Main Installation are bat (species undetermined), coyote (*Canis latrans*), opossum (*Didelphis virginiana*), woodchuck (*Marmota monax*), meadow vole (*Microtus pennsylvanicus*), house mouse (*Mus musculus*), white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), and red fox (*Vulpes vulpes*). Larger species may be transient and have small populations due to limited amount of habitat, but smaller mammals that require less space have relatively large populations.

Ten species of plants on the Base are state-listed threatened or endangered plants. A few species of birds seen on the site are state-listed threatened or endangered, but were classified by the survey investigator as migrants, and not breeding birds. No species of mammal, fish, reptile, amphibian, or invertebrate at the site are on the state-listed threatened and endangered species lists.

### **1.1.2 Contaminants Ecotoxicity and Fate and Transport**

Based on the historical data from the site, several classes of chemicals have the potential to be present at the site. These include metals, VOCs, PAHs and other SVOCs, PCBs, and pesticides. The following sections present a brief discussion regarding the toxicity, potential food chain and trophic transfer, and fate and transport properties of each class of contaminants.

#### **1.1.2.1 Physical and Chemical Characteristics**

Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include biota-sediment accumulation factors (BSAFs), organic carbon partition coefficients and octanol water partition coefficients. The following paragraphs discuss the significance of each factor.

Biota-sediment accumulation factors (BSAFs) will be used to predict contaminant concentrations in fish tissue from contaminant concentrations in sediment. The BSAFs for the organic compounds will be obtained from The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1: National Sediment Quality Survey (U.S. EPA, 1997b) and other literature, as deemed appropriate. Fish BSAFs for metals are not available so a default value of 1.0 will be used for the metals.

The organic carbon partition coefficient ( $K_{oc}$ ) measures the tendency for a chemical to partition between water and soil or sediment particles that contain organic carbon. This coefficient is important in the ecological environment because it determines how strongly an organic chemical will bind to the organic carbon in soil or sediment.

The octanol/water partition coefficient ( $K_{ow}$ ) is the ratio of a chemical concentration in octanol divided by the concentration in water. The octanol/water partition coefficient has been shown to correlate well with bioconcentration factors in aquatic organisms and with adsorption to soil or sediment.

The  $K_{oc}$ s,  $K_{ow}$ s, and BSAFs for the contaminants detected in the sediment will be included in the Screening-Level ERA.

### **1.1.2.2 Metals**

Many metals occur naturally at various concentrations in the surface water, sediment, and/or soil due primarily to chemical weathering of rocks and fallout from volcanoes. Most metals are toxic to aquatic (i.e., fish, invertebrates) and terrestrial (i.e., plants, invertebrates, vertebrates) ecological receptors above certain concentrations, with some metals being more toxic at lower concentrations than others. Also, different chemical forms of the metals may be more toxic than others. For example, hexavalent chromium is typically more toxic than trivalent chromium, and methylmercury is more toxic than inorganic mercury. In addition, the toxicity of several metals (cadmium, chromium, copper, lead, nickel, silver, and zinc) to aquatic receptors in freshwater systems decreases with increasing water hardness.

Many factors (e.g., pH, Eh, clay content, organic matter content) influence the bioavailability of metals to invertebrates in sediment. One way to estimate the bioavailable portion of certain divalent metals (cadmium, copper, lead, nickel, and zinc) in sediment is to measure the amount of acid volatile sulfides (AVS) and simultaneously extracted metals (SEM) in a sediment sample. If the molar concentration of AVS is higher than the molar concentration of SEM, then the SEM metals are expected to be unavailable to aquatic invertebrates and, therefore, nontoxic. AVS plays little or no role in determining interstitial water concentrations of metals in aerobic systems or those with low productivity (i.e., where the absence of organic carbon limits sulfate reduction) (Ankley et al., 1996), or when ingestion of sediments is the primary exposure route (Lee et al., 2000).

### **1.1.2.3 Semivolatile Organic Compounds**

The most common semivolatile organic compounds that are found at naval facilities include polynuclear aromatic hydrocarbons (PAHs) and phthalates. PAHs are a diverse group of compounds consisting of two or more substituted and unsubstituted polynuclear aromatic rings formed by the incomplete combustion of carbonaceous materials. PAHs are ubiquitous in the modern environment and commonly are constituents of coal tar, soot, vehicle exhaust, cigarette smoke, certain petroleum products, road tar, mineral oils, creosote, and many cooked foods. PAHs also are released to the environment through natural sources such as volcanoes and forest fires.

PAHs are transferred from surface water by volatilization and sorption to settling particles. The compounds are transformed in surface water by photooxidation, chemical oxidation, and microbial metabolism (ATSDR, 1989a). In soil and sediments, microbial metabolism is the major process for degradation of PAHs (ATSDR, 1989a). Although PAHs accumulate in terrestrial and aquatic plants,

many organisms are able to metabolize and eliminate these compounds. Vertebrates can readily metabolize PAHs, but lower forms (insects and worms) cannot metabolize PAHs as quickly. Food chain uptake does not appear to be a major exposure source to PAHs for aquatic animals (ATSDR, 1989a).

PAHs vary substantially in their toxicity to aquatic organisms. In general, toxicity increases as molecular weight increases, with the exception of some high molecular weight PAHs that have low acute toxicity. Most species of aquatic organisms rapidly accumulate PAHs that occur at low concentrations in the ambient medium. However, uptake of PAHs is highly species-specific, it is higher in algae, mollusks, and other species that are incapable of metabolizing PAHs (Eisler, 1987). The ability of fish to metabolize PAHs may explain why benzo(a)pyrene is frequently not detected or is found at only very low levels in fish from environments heavily contaminated with PAHs (ATSDR, 1989a). BSAFs for PAHs are listed as 0.29 (U.S. EPA, 1997b).

Phthalates are semivolatile organic compounds that are used in production of plastics (ATSDR, 1993). Most phthalates are expected to sorb to soil or sediment particles after their release because of their high Log  $K_{oc}$  values (Howard, 1989). Some phthalates may bioconcentrate in aquatic organisms [Spectrum Laboratories, 1999; Howard, 1989; ATSDR, 1989a].

#### **1.1.2.4 Pesticides**

Pesticides are used to control pestiferous invertebrates and, therefore, they are toxic to many soil and aquatic invertebrates. In addition, many pesticides are toxic to ecological receptors at higher trophic levels such as mammals and birds. For example, DDT compounds have been linked to eggshell thinning and subsequent decreased survival of several birds of prey (such as eagles and falcons). Other pesticides such as chlordanes, dieldrin, aldrin, endrin, and heptachlor also are very toxic to mammals and birds (Newell et al., 1987).

Organochlorine insecticides such as DDT, chlordane, aldrin, dieldrin, heptachlor, endosulfan, and endrin and their associated breakdown products generally degrade very slowly and tend to be soluble in lipids. These result in bioaccumulation and possible increases in concentrations through food webs (Newman, 1998). Pesticides have high Log  $K_{oc}$  values so they are expected to sorb strongly to soil and sediment particles when released to the environment. Consequently, these compounds may migrate from their site of application when the soil is eroded, although they will not have a tendency to leach to groundwater.

DDT, DDE and DDD are highly lipid soluble, which combined with an extremely long half-life, results in bioaccumulation (ATSDR, 1989b). When present in ambient water, DDT and its metabolites are

concentrated in freshwater and marine plankton, insects, mollusks, and other invertebrates and fish (ATSDR, 1989b). A progressive accumulation of residues may result in high levels of residues in organisms at the top of the food chain (ATSDR, 1989b). Moderate to significant bioconcentration in aquatic species has been reported for dieldrin, with bioconcentration factors (BCFs) ranging from 100 to 10,000 (Howard, 1991). Heptachlor also has been reported to bioconcentrate in aquatic species, with bioconcentration factors in fish up to about 20,000 (Howard, 1991).

Chlordane will bioconcentrate in both marine and freshwater species (ATSDR, 1989c). In living organisms, chlordane concentrations are usually highest in samples collected near areas where chlordane was used to control termites or other pests, in predatory species, and in tissues with high lipid content (Eisler, 1990). Food chain biomagnification is low except in certain marine mammals (Eisler, 1990).

BSAFs for pesticides range from 0.28 for DDD to 7.7 for DDE (U.S. EPA, 1997a).

#### **1.1.2.5 PCBs**

The term polychlorinated biphenyls (PCBs) commonly refers to a variety of mixtures of individual biphenyl isomers, each consisting of two joined benzene rings and up to 10 chlorine atoms. Mixtures of these isomers are known by their commercial designation of Aroclor. This trade name is followed by a four-digit number; the first two numbers indicate the type of isomer mixture and the last two numbers indicate the approximate weight percent of chlorine in the mixture (U.S. EPA, 1985).

PCBs released into water adsorb to sediments and other organic matter. Typically, PCB concentrations are greater in the sediment and suspended material than in the water column. Substantial quantities of PCBs in aquatic sediments can act as an environmental reservoir from which PCBs may be released slowly over a long period of time (ATSDR, 1989d). For PCBs that exist in the dissolved state in water, volatilization becomes the primary fate process. PCBs have the capability to bioaccumulate and biomagnify (U.S. EPA, 1985).

Degradation of PCBs in the environment is dependent upon the degree of chlorination. Generally, the more chlorinated the PCB molecule, the more persistent it will be in the environment. Factors that determine biodegradability include the amount of chlorination, concentration, type of microbial population, available nutrients, and the temperature (ATSDR, 1989d).

Because PCBs are highly lipophilic, they can bioaccumulate in the lipid portions of animals. Bioconcentration factors in the thousands have been reported for various aquatic species (Eisler, 1986a). PCBs also can accumulate in upper trophic level animals such as piscivorous birds and mammals that feed on contaminated prey items (Eisler, 1986a). BSAFs for PCBs were reported as 1.85 (U.S. EPA, 1997).

Adverse effects of PCBs on terrestrial wildlife include increased mortality, reproductive effects, and behavioral effects (U.S. EPA, 1985). As a group, birds are more resistant to acutely toxic effects of PCBs than mammals (Eisler, 1986a). Among sensitive avian species, PCBs disrupt the normal pattern of growth, reproduction, metabolism, and behavior (Eisler, 1986a). Of the mammals, the mink is the most sensitive wildlife species tested for which data are available (Eisler, 1986a). Impacts to mink include anorexia, weight loss, lethargy, reproductive effects, and death (Eisler, 1986a).

#### **1.1.2.6 Volatile Organic Compounds**

VOCs are usually very mobile in the environment because they are poorly adsorbed to soil and sediment particles. Also, because they are very volatile, they typically are only detected in surface water, surface soil, and sediment at low concentrations.

Most VOCs have very little potential to bioaccumulate in ecological receptors; therefore, biomagnification through the food chain does not appear to be significant. VOCs are not expected to biomagnify in plants and are typically toxic to ecological receptors at relatively high concentrations.

#### **1.1.3 Potential Exposure Pathways**

The primary sources of contaminants in Pettibone Creek are historic discharges to the creek through upstream discharges. However, Pettibone Creek may still be receiving contaminant inputs via the storm sewers or through upstream dischargers. Figure 1-2 presents the conceptual site model.

Potential ecological receptors (e.g., benthic macroinvertebrates and fish) can be exposed to contaminants in the surface water and sediment of Pettibone Creek by direct contact and incidental ingestion of surface water and sediment. Also, mammals and birds can be exposed to contaminants in the surface water and sediment of Pettibone Creek by direct contact, ingestion of contaminated food items, and incidental ingestion of surface water and sediment. Note that exposure of terrestrial wildlife to contaminants in the surface water and sediment via dermal contact is unlikely to represent a major exposure pathway

because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of contaminants across dermal tissue. Therefore, the dermal pathway will not be evaluated in the Screening-Level ERA.

#### **1.1.4 Endpoints**

##### **1.1.4.1 Assessment Endpoints**

Assessment endpoints are an explicit expression of the environmental value that is to be protected (U.S. EPA 1997a). The selection of endpoints is based on the habitats present, the migration pathways of probable contaminants, and the routes that contaminants may take to enter receptors. For this Screening-Level ERA the assessment endpoints are protecting the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Piscivorous birds
- Piscivorous mammals
- Benthic invertebrates
- Fish

The following paragraphs discuss why the assessment endpoints were selected for this Screening-Level ERA.

*Piscivorous Birds and Mammals:* Piscivorous birds and mammals consume sediment invertebrates and fish that are potentially present in the Pettibone Creek. Piscivorous wildlife may be exposed to contaminants that are present in the food items they consume.

*Benthic Macroinvertebrates and Fish:* Benthic macroinvertebrates and fish serve as a food source for higher trophic organisms (i.e., fish, amphibians, birds, mammals), and are likely to be present in Pettibone Creek. They may be at risk from direct exposure to contaminants in the surface water or sediment. Also, benthic invertebrates and fish can accumulate contaminants that may be transferred to the higher trophic organisms.

##### **1.1.4.2 Measurement Endpoints**

Measurement endpoints are estimates of biological impacts (e.g., mortality and adverse effects on growth and reproduction) that are used to evaluate the assessment endpoints. The following measurement endpoints will be used to evaluate the assessment endpoints in this Screening-Level ERA.



- No observed adverse effects levels (NOAELs) for surrogate wildlife species – Survival of, and reproductive, and/or developmental effects to piscivorous birds and mammals will be evaluated by comparing the ingested dose from contaminants in the surface water, sediment, and fish to NOAELs.
- Sediment screening values – Mortality and other adverse effects (i.e., those to growth, feeding rates, and behavior) to benthic macroinvertebrates will be evaluated by comparing the measured concentrations of chemicals in the sediment to screening values designed to be protective of ecological receptors.
- Surface water screening values – Mortality and other adverse effects (i.e., those to growth, feeding rates, and behavior) to aquatic organisms will be evaluated by comparing the measured concentrations of chemicals in the surface water to screening values designed to be protective of ecological receptors.

#### **1.1.4.3 Selection of Receptor Species**

Many receptors in the aquatic environment are adequately described in general categories such as fish and sediment-dwelling (benthic) invertebrates. This is due to the general nature of the threshold values, effects values, or water quality criteria that are typically used to characterize risk for such organisms. Therefore, specific benthic invertebrates and fish species will not be selected as indicator receptor species.

In order to evaluate potential risks to terrestrial wildlife, indicator species with known exposure factors (e.g., body weights and ingestion rates) need to be selected. Indicator wildlife species are selected for their preferred habitat, body size, sensitivity, home range, abundance, commercial or sport utilization, legal status, and functional role (e.g., predators). For conservativeness, indicator species are typically small and have small home ranges. Species known to be sensitive to particular contaminants may be selected, or toxicity values for those species may be used. For example, mink are sensitive to PCBs for reproductive endpoints and therefore mink TRVs would be selected for a scenario involving exposure to PCBs from an aquatic or sedimentary source. The availability of exposure parameters such as body mass, feeding rate, and drinking rate may also be a factor in selecting indicator species. The following indicator species will be used for the food chain modeling (discussed in more detail later in this Work Plan):

- Piscivorous mammals: Raccoon

- Piscivorous birds: Belted Kingfisher

Receptor profiles for each of these species are presented in Attachment 1.

### **1.1.5 Ecological Effects Evaluation**

The preliminary ecological effects evaluation is an investigation of the relationship between the magnitude of exposure to a chemical and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicity study, it may also include descriptions of apparent effects seen during the site visit. Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as surface water for aquatic organisms or sediment for sediment invertebrates. For other receptors, such as terrestrial vertebrates, toxicity data are typically available as doses, with units equal to mass of contaminant per unit of body mass per unit of time (usually mg/kg-day).

As the first step in the ecological effects evaluation, COPCs will be selected by comparing the contaminant concentrations in the surface water and sediment to screening values developed for each media. The COPCs will be selected by comparing the maximum contaminant concentrations in the surface water or sediment to screening values presented in Section A of the QAPP. Calcium, magnesium, potassium, and sodium will not be retained as COPCs in any medium because of their relatively low toxicity to ecological receptors and their high natural variability. Contaminants without screening values will be retained as COPCs but they may only be evaluated qualitatively.

If a chemical is non-detected at the reporting limit in the samples in a particular media, and the reporting limit exceeds the screening level, the chemical will not be quantitatively carried through the risk assessment as a COPC. However, the chemical, its reporting limit, and the screening level will be summarized in a table and qualitatively discussed in the uncertainty analysis section. If a chemical is detected in at least one sample at levels greater than the reporting limit, one-half of the reporting limit will be substituted for the non-detects for calculating summary statistics (e.g., mean concentrations).

#### **1.1.5.1 Surface Water Screening Values**

The surface water screening values (SWSVs) that will be used to evaluate the quality of the surface water were compiled from several different sources. The following bulleted list presents the order in which the sources were used and the paragraphs following the bulleted list describe the sources:

- IEPA Water Quality Standards (WQS) (IEPA, 1999)
- IEPA Water Quality Criteria (WQC) (IEPA, 2000a)
- U.S. EPA Recommended Water Quality Criteria (WQC) (U.S. EPA, 1999)
- U.S. EPA Ecotox Thresholds (U.S. EPA, 1996)
- Oak Ridge National Laboratory Surface Water Benchmarks (Suter and Tsao, 1996)

The IEPA WQS are the concentrations of toxic substances that will not result in acute or chronic toxicity to aquatic life. Most of the metals WQS will be based on dissolved metals in accordance with the Illinois WQS (IEPA, 1999). Also note that the values from Subpart E of the regulations will be used because Pettibone Creek are located within the Lake Michigan Basin (IEPA, 2000a). IEPA has also developed WQC for several chemicals that are used to evaluate the quality of surface water bodies. These values were selected first because they are specific to Illinois and are enforceable standards.

The U.S. EPA Recommended WQC were developed by U.S. EPA to provide states with guidance for developing their own criteria (U.S. EPA, 1999). These values are set to protect the majority of aquatic organisms from adverse impacts from contaminants in the surface water. These values were selected next because they are based on U.S. EPA guidance.

The Ecotox Thresholds document was prepared by U.S. EPA for use as benchmark screening values in the first step of a baseline risk assessment (U.S. EPA, 1996). Most of the surface water Ecotox Thresholds for the contaminants that are evaluated in this Screening-Level ERA are based on Suter and Mabrey, (1994) in the Ecotox Thresholds. Because Suter and Mabrey (1994) has been updated, Suter and Tsao (1996) values will be used when the Ecotox Thresholds were based on the Suter and Mabrey (1994) data. The Suter and Tsao (1996) benchmarks were calculated using Tier II methodology as described in the U.S. EPA's Proposed Water Quality Guidance for the Great Lakes System (U.S. EPA, 1993a). Tier II values are developed so that aquatic benchmarks could be established with fewer data than are required for the U.S. EPA WQC. These values were used last because most of them are not regulatory in nature. However, they are commonly used as screening values in ecological risk assessments.

#### **1.1.5.2 Sediment Screening Values**

The IEPA has developed a Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediments (IEPA, 2000b). IEPA has also adopted a sediment sieving procedure that is used for some projects. This procedure includes sieving sediment samples through a 63-micron sieve, and

analyzing the fine material that passes through the sieve. It was determined that the sieving procedure is not applicable for this project for the following reasons:

1. In addition to the IEPA sediment screening numbers, the chemical concentrations in the sediment samples will be compared to other sediment benchmarks, as discussed below. All of those sediment benchmarks are based on bulk sediment concentrations, not sieved sediment concentrations. Therefore, if the sediment were sieved, a direct comparison to those sediment benchmarks would not be applicable.
2. Some of the sediment criteria can be normalized for the amount of organic carbon in the sediment, which is the basic premise for sieving the samples.
3. Based on the site visit, the sediment in Pettibone Creek and the boat basin consisted primarily of sand. Therefore, sediment over a very large area would need to be collected in order to obtain enough fine-grained material for analysis.

The IEPA Tiered approach begins first with a comparison of maximum sediment concentrations to baseline sediment screening numbers (for organics) or a comparison to background levels (for inorganics). The document titled Evaluation of Illinois Stream Sediment Data 1982-1995 includes a table of unsieved sediment data (IEPA, 1997). The non-elevated values from Appendix A of the document (unsieved sediment) will be compared to the site data to determine if a chemical should be retained as a COPC. For chemicals that are not listed in Appendix A, the non-elevated levels from Table 5 (sieved sediment) will be used because the mean values in the sieved and unsieved data sets were not significantly different.

The following equation from the Tiered Approach document (IEPA, 2000b) will be used to calculate sediment screening concentrations for chemicals that do not have sediment screening values:

$$SSC = WQC \times K_{oc} \times F_{oc}$$

Where:

- SSC = Sediment screening concentration (mg/kg)
- WQC = Water quality criterion (mg/L)
- $K_{oc}$  = Organic carbon partition coefficient (L/kg)
- $F_{oc}$  = Fraction of organic carbon measured in the sediment (unitless)

The chemical-specific  $K_{oc}$  values will be obtained from IEPA and the  $F_{oc}$  will be 0.006 which is the default value in the IEPA Tiered Approach to Corrective Action Objectives (TACO) for surface soils (no value was available in TACO for sediment) (IEPA, 1996). These calculated values will then be compared to the

lower effects concentrations in the following documents, and the lower of the values will be used for the screening:

- Ecotox Thresholds (U.S. EPA, 1996)
- Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (OMOE, 1993)
- Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments (Long et al., 1995)

The sediment Ecotox Thresholds include draft U.S. EPA Sediment Quality Criteria (SQC) that have been established for two contaminants (dieldrin and endrin), Sediment Quality Benchmarks (SQB) that have been established using equilibrium partitioning, and Effects Range-Low values from Long et al., (1995). The SQC and SQBs Ecotox Thresholds are based on an assumption of 1 percent organic carbon [10,000 mg/kg total organic carbon (TOC)]. The SQBs calculated in U.S. EPA (1996) are based on freshwater data.

The "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario" (OMOE, 1993) are based on freshwater studies. The Lowest Effects Levels (LEL) (see below) will be used as the screening values, when available. The OMOE guidelines establish three effects levels, as follows:

- **No Effect Level (NEL):** Sediment will not affect fish or sediment-dwelling organisms. In addition, no transfer through the food chain and no effect on water quality is expected.
- **Lowest Effect Level (LEL):** Sediment is considered marginally polluted but will not affect the majority of sediment-dwelling organisms.
- **Severe Effect Level (SEL):** Sediment is considered highly polluted and likely to affect the health of sediment-dwelling organisms.

The "Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments" (Long et al., 1995) will be used when freshwater sediment screening values are not available. The Effects-Range Low (ER-L) (see below) will be used as the screening values. Long et al. (1995) establishes three effects levels, as follows:

- **Effects Range-Low (ER-L):** (Effects Range-Low) Minimal-effects range (adverse effects would be rarely observed);

- **Between ER-L and Effects Range-Median (ER-M):** Possible-effects range (adverse effects would occasionally occur); and
- **Effects Range-ER-M:** Probable-effects range (adverse effects would probably occur).

#### 1.1.5.3 Terrestrial Food Chain Modeling

The above-mentioned screening values are not designed to screen out risks to piscivorous wildlife. Therefore, in addition to comparing the surface water and sediment concentrations to screening values, risk to piscivorous receptors to the contaminants in the sediment will be determined by estimating the Chronic Daily Intake (CDI) and comparing the CDI to Toxicity Reference Values (TRVs) representing acceptable daily doses in mg/kg-day. The TRVs will be developed from No-Observed-Adverse-Effect-Levels (NOAELs) and Lowest-Observed-Adverse-Effect-Levels (LOAELs) obtained from wildlife studies, if available. The majority of the TRVs will be obtained from the ORNL Toxicological Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996). Toxicity data in the Agency for Toxic Substances and Disease Registry toxicity profiles and Integrated Risk Information System printouts will be utilized, if necessary.

For avian species, the NOAEL (or LOAEL) for the test species will be used as the NOAEL (or LOAEL) for the surrogate species in accordance with Sample et al. (1996). For mammalian species, the NOAEL (or LOAEL) for the test species will be adjusted to a NOAEL (or LOAEL) for the indicator species using the following body weight scaling equation from Sample et al., (1996):

$$\text{NOAEL}_w = \text{NOAEL}_t * (\text{bw}_t / \text{bw}_w)^{1/4}$$

Where:  $\text{NOAEL}_w$  = No Observed Adverse Effect Level for the surrogate wildlife species

$\text{NOAEL}_t$  = No Observed Adverse Effect Level for the test species

$\text{bw}_t$  = body weight of the test species

$\text{bw}_w$  = body weight of the surrogate test species

The body weight scaling is done because studies have shown that for mammals, numerous physiological functions such as metabolic rate, as well as responses to toxic chemicals, are a function of body size (Sample et al., 1996). Note that the average body weights of the species will be used for the calculations. Sample et al., (1996) indicated that physiological scaling factors may not be appropriate for birds. Therefore, scaling factor of 1.0 will be used for birds in the Screening-Level ERA.

Table 1 presents the body weights that will be used for the surrogate and potential test species. If a subchronic study is used to develop the TRV, the final value will be multiplied by a factor of 0.1 to account for uncertainty between subchronic and chronic effects. Also, if a LOAEL study is used to develop the NOAEL TRV, then the LOAEL will be multiplied by a factor of 0.1 to obtain the NOAEL. Finally, the estimated doses will incorporate literature-based sediment-to-fish BSAFs.

Exposure of the terrestrial receptors to the contaminants in the surface water, sediment, and fish will be determined by estimating the daily doses in mg/kg-day using exposure equations. The following equation presents the food chain model that will be used for the piscivorous indicator species that were selected for modeling:

$$CDI(\text{inorganics}) = \frac{[(Cs * BAF * If) + (Cs * Is) + (Cw * Iw)] * H}{BW}$$

$$CDI(\text{organics}) = \frac{[(Cs * BSAF * \frac{\%L}{\%TOC}) * If) + (Cs * Is) + (Cw * Iw)] * H}{BW}$$

Where:

CDI	=	Chronic daily intake (mg/kg-day)
Cs	=	Contaminant concentration in sediment (mg/kg)
BAF	=	Sediment-to biota bioaccumulation factor (for inorganics) (unitless)
BSAF	=	Sediment-to biota bioaccumulation factor (for organics) (unitless)
If	=	Ingestion rate of food (kg/day)
%L	=	Percent lipids of the fish (%)
%TOC	=	Percent total organic carbon of the sediment (%)
Is	=	Rate of incidental sediment ingestion (kg/day)
Cw	=	Contaminant concentration in water (mg/L)
Iw	=	Ingestion rate of water (L/day)
H	=	Contaminated area/home area range area ratio (unitless)
BW	=	Body weight (kg)

The following input parameters will be used in the CDI equation:

- Maximum surface water and sediment concentration
- Conservative receptor body weight for CDI equation
- Conservative receptor ingestion rate
- Receptors spend 100% of their time at the site

The exposure assumptions (i.e., ingestion rate and body weight) will be obtained from the Wildlife Exposure Factors Handbook (U.S. EPA, 1993b), or other literature sources, if necessary. Table 1 presents the exposure parameter that will be used in the Screening-Level ERA. Attachment 2 presents the values that were used to calculate the exposure parameters and a discussion of how they were calculated.

#### 1.1.6 Ecological Risk Characterization

The risk characterization is the final phase of a risk assessment that compares the exposure to the ecological effects. It is at this phase that the likelihood of adverse effects occurring as a result of exposure to a contaminant will be evaluated. An Ecological Effects Quotient (EEQ) approach will be used to characterize the risk to terrestrial receptors. This approach characterizes the potential effects by comparing exposure concentration with the effects data. An EEQ less than "1.0" indicates that potential risk to the receptors is low. However, an EEQ greater than "1.0" does not indicate that potential receptors are at risk; it only indicates that the conservative screening values were exceeded and the data should be further evaluated. The EEQ is not an expression of probability, and the meaning of values greater than 1.0 must be interpreted in light of uncertainties in risk management. The EEQ for the aquatic receptors will be calculated as follows:

$$EEQ = \frac{C_{sw}}{SWSV} \text{ or } \frac{C_{sd}}{SSV}$$

Where: EEQ = Hazard Quotient, (unitless)

$C_{sw}$  = Contaminant concentration in surface water, ( $\mu\text{g/L}$ )

$C_{sd}$  = Contaminant concentration in sediment, ( $\mu\text{g/kg}$  or  $\text{mg/kg}$ )

SWSV = Surface Water Screening Value, ( $\mu\text{g/L}$ )

SSV = Sediment Screening Value, ( $\mu\text{g/kg}$  or  $\text{mg/kg}$ )

The EEQ for the piscivorous wildlife model will be calculated as follows:



$$EEQ = \frac{\text{Dose}}{\text{TRV}}$$

Where: EEQ = Hazard Quotient, (unitless)

Dose = Daily Intake Dose, (mg/kg-day)

TRV = Toxicity Reference Value (NOAEL or LOAEL), (mg/kg-day)

## 1.2 STEP 3A – REFINEMENT OF COPCS

Step 3a refines the list of COPCs from the Screening-Level ERA using less conservative benchmarks and more site-specific exposure assumptions (where available) to more realistically estimate potential risks to ecological receptors (i.e., plants, invertebrates, and aquatic receptors). For example, both maximum and average media concentrations will be compared to the benchmark values because the average concentration is a more realistic estimation of average exposure. This evaluation also may include (but is not necessarily limited to) a consideration of the following topics:

- Magnitude of criterion exceedence: Although risks may not relate directly to the magnitude of a criterion exceedence, the magnitude may be one factor used in a weight-of-evidence approach to determine the need for further site evaluation.
- Frequency of chemical detection: A chemical that is detected at a low frequency typically will be of less concern than a chemical detected at higher frequency provided that toxicity and concentrations of the constituents are similar. All else being equal, chemicals detected frequently will be given greater consideration than those detected relatively infrequently.
- Contaminant bioavailability: Many contaminants (especially metals) are present in the environment in forms that are typically not bioavailable and the limited bioavailability will be considered when evaluating the exposures of receptors to site contaminants.
- Habitat: Although exceedences of criteria may occur, potential risks to ecological receptors may be minimal if there is little habitat for those receptors. Therefore, the extent of habitat will be used qualitatively when considering the site for additional evaluation.
- Alternate Benchmarks: Less conservative values/toxicity data will be used to reevaluate the chemicals that are retained as COPCs to determine if the detected concentrations exceed the higher effects levels. These alternate values will include, but not be limited to the following items:

- Acute water quality standards
  - Higher effects sediment concentrations (e.g., SELs, ER-Ms)
  - Laboratory toxicity data
- Realistic Food Chain Models: The exposure doses from the terrestrial food chain models will be recalculated using less conservative exposure assumptions (e.g., average ingestion rates, body weights and contaminant concentrations) to determine an average risk. Also, the doses will be compared to NOAELs and LOAELs in this step.

### **1.3 Ecological Risk Uncertainty Analysis**

This section presents some of the uncertainties associated with ERAs.

#### **1.3.1 Measurement and Assessment Endpoints**

Measurement endpoints are used to evaluate the assessment endpoints that are selected for the Screening-Level ERA. For this Screening-Level ERA, the measurement endpoints are not the same as the assessment endpoints. Therefore, the measures are used to predict effects to the assessment endpoints by selecting surrogate species that will be evaluated.

#### **1.3.2 Exposure Characterization**

There is uncertainty in the chemical data that are collected at the site. Measured levels of chemicals are only estimates of the true site chemical concentrations. For samples that are deliberately biased toward known or suspected high concentrations, predicted doses probably will be higher than actual doses to the receptors. This is because it is not likely that the receptor will feed only in contaminated areas.

Under the conservative exposure scenario, terrestrial wildlife are assumed to live and feed only at the site. These assumptions will tend to overpredict risk because it is unlikely that most receptors will obtain all their food from within the site boundaries.

#### **1.3.3 Ecological Effects Data**

There is uncertainty in the ecological toxicity value comparison. The water quality criteria developed by U.S. EPA in theory protects 95 percent of the exposed species. Therefore, some sensitive species present at the site may not be protected by the use of these criteria. There also may be situations where

the surface water screening values (SWSVs) are over-predictive of risk if the sensitive species used to develop the criteria do not inhabit the site. Finally, with the exception of hardness for a few metals, the SWSVs do not account for site-specific factors, such as TOC or pH, which may affect toxicity.

The toxicity of chemical mixtures is not well understood. The toxicity information used in the Screening-Level ERA for evaluating risk to the ecological receptors is for individual chemicals. Chemical mixtures can affect the organisms very differently than the individual chemicals because of synergistic or antagonistic effects.

Finally, toxicological data for some of the contaminants may not exist. Therefore, there is uncertainty in the conclusions involving the potential impacts to ecological receptors from these constituents.

#### **1.2.8.4 Risk Characterization**

Risks are projected if an EEQ is greater than or equal to unity regardless of the magnitude of the EEQ. Although the relationship between the magnitude of an EEQ and toxicity is not necessarily linear, the magnitude of an EEQ can be used as rough approximation of the extent of potential risks, especially if there is sufficient confidence in the guideline used. Finally, there is uncertainty in how the predicted risks to individuals at the site translate into risk to the population in the area as a whole.

Agency for Toxic Substances and Disease Registry (ATSDR). 1989a. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Public Health Service. Atlanta, Georgia. October.

Agency for Toxic Substances and Disease Registry (ATSDR). 1989b. Toxicological Profile for p,p'-DDT, p,p'-DDE and p,p'-DDD. U. S. Public Health Service. April.

Agency for Toxic Substances and Disease Registry (ATSDR). 1989c. Toxicological Profile for Chlordane. U. S. Public Health Service. April.

Agency for Toxic Substances and Disease Registry (ATSDR). 1989d. Toxicological Profile for Selected PCBs (Aroclor -1260, -1254, -1242, -1232, 1221, and 1016). U.S. Department of Public Health. Atlanta, Georgia. June 1989.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Toxicological Profile for Di(2-ethylhexyl)phthalate. U.S. Public Health Service, as found in Lakes Environmental Toxic Factsheet web site (<http://www.lakes-environmental.com>).

Ankley, Gerald T., D.M. Di Toro, D.J. Hansen, and W.J. Berry. 1995. Technical Basis and Proposal for Deriving Sediment Quality Criteria for Metals. Environmental Toxicology and Chemistry. Vol. 15(12), pp. 2056-2066.

DON (Department of the Navy). 1999. Navy Policy For Conducting Ecological Risk Assessments. Memo from Chief of Naval Operations to Commander, Naval Facilities Engineering Command, 05 April 1999. Department of the Navy, Washington, DC.

Eisler, Ronald. 1986. PCB Hazards to Fish, Wildlife, and Invertebrates. A Synoptic Review. Patuxent Wildlife Research Center, US Fish and Wildlife Service. Biological Report 85 (1.7). April.

Eisler, Ronald. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. US Department of Interior - Fish and Wildlife Service. Biological Report 85 (1.11). May

Eisler, Ronald. 1990. Chlordane Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Department of the Interior. Fish and Wildlife Service. Biological Report 85(1.21). July.

Great Lakes Naval Training Center. 2000. Restoration and Maintenance Plan for Pettibone Creek Ravine. Survey report prepared by Environmental Quality Management, Inc. July 2000.

Howard, Philip, ed. 1989. Handbook and Environmental Fate and Exposure Data for Organic Chemicals, Volume I – Large Production and Priority Pollutants. Lewis Publishers, Inc.

Howard, Phillip H. 1991. Fate and Exposure Data for Organic Chemicals, Volume III Pesticides. Lewis Publishers, Inc.

IEPA (Illinois Environmental Protection Agency), 2000a. Listing of Derived Water Quality Criteria pursuant to 35 Ill. Adm. Code 302, Subpart F. June 9.

IEPA (Illinois Environmental Protection Agency), 2000b. Tiered Approach for Evaluation and Remediation of Petroleum Product Releases to Sediments. Draft, Update 2. Office of Chemical Safety. September 21.

IEPA (Illinois Environmental Protection Agency), 1999. Title 35: Environmental Protection Subtitle C: Water Pollution Chapter I: Pollution Control Board Part 302 Water Quality Standards. Effective August 26.

IEPA (Illinois Environmental Protection Agency), 1997. Evaluation of Illinois Sieved Stream Sediment Data, 1982-1995. Bureau of Water. IEPA/BOW/97-016. August.

IEPA, 1996. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online March, 2001.

Lee, Byeong-Gweon, Sarah B. Griscom, Jung-Suk Lee, Heesun J. Choi, Chul-Hwan Koh, Samuel N. Luoma, and Nicholas S. Fisher. 2000. Influences of Dietary Uptake and Reactive Sulfides on Metal Bioavailability from Aquatic Sediments. *Science*, Volume 287, pp. 282-284. January 14.

Long, Edward, R., D.D. MacDonald, S.L. Smith, F.D. Calder. 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. 1995.

Newman, Michael C. 1998. *Fundamentals of Ecotoxicology*. Ann Arbor Press, Chelsea Michigan.

Newell, A.J., D.W. Johnson, and L.K. Allen. 1987. Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife. New York Department of Environmental Conservation. Division of Fish and Wildlife, Bureau of Environmental protection. Technical Report 87-3. July.

OMOE, 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy. August.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory. June. ES/ER/TM-86/R3.

Spectrum Laboratories. 1999. Chemical Fact Sheets (<http://www.speclab.com>).

Suter, G.W. II. and J.B. Mabrey. 1994. Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1994 Revision. Environmental Sciences Division, Oak Ridge National Laboratory.

Suter, G.W. II. and C.L. Tsao. 1996. Toxicological Benchmarks for Screening Potential Constituents of Concern for Effects on Aquatic Biota:1996 Revision. Environmental Sciences Division, Oak Ridge National Laboratory. ES/ER/TM-96/R2.

U.S. EPA (U.S. Environmental Protection Agency), 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Office of Solid Waste and Emergency Response. Washington, D.C. September.

U.S. EPA (U.S. Environmental Protection Agency), 1993a. Water Quality Guidance for the Great Lakes System and Correction: Proposed Rules. Federal Register. 58(72) 20802-21047.

U.S. EPA (U.S. Environmental Protection Agency), 1993b. Wildlife Exposure Factors Handbook. Office of Research and Development. Washington, D.C. December 1993. EPA/600/R-93/187a.

U.S. EPA (U.S. Environmental Protection Agency), 1996. ECO Update, Ecotox Thresholds. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Intermittent Bulletin, Volume 3, Number 2. EPA540/F-95/038. January.

U.S. EPA (U.S. Environmental Protection Agency), 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Environmental Response Team. June 5.

U.S. EPA (U.S. Environmental Protection Agency), 1997. The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1: National Sediment Quality Survey. Office of Science and Technology. Washington, D.C. EPA 823-R-97-006. September.

U.S. EPA (U.S. Environmental Protection Agency), 1998. Final Guidelines for Ecological Risk Assessment. Effective April 30.

U.S. EPA (U.S. Environmental Protection Agency), 1999. National Recommended Water Quality Criteria-Correction. Office of Water. EPA 822-Z-99-001. April.

U.S. Navy. 1990. Natural Resources Management Plan Naval Training Center Great Lakes IL. 1990 through 1994. Northern Division, Naval Facilities Engineering Command, September 18, 1990.

U.S. Navy. 1995. Integrated Natural Resources Plan, Great Lakes Naval Training Center. Naval Training Center, Great Lakes, Illinois. October 1995.

U.S. Navy. 2000a. Flora and fauna survey, Naval Training Center Great Lakes, Illinois. Survey report prepared by Environmental Quality Management, Inc. August 2000.

TABLE 1

**EXPOSURE PARAMETERS FOR TEST SPECIES AND SURROGATE WILDLIFE SPECIES**  
**SITE 17**  
**NTC GREAT LAKES, ILLINOIS**

Species	Body Weight (kg)			Food Ingestion Rate (kg/day)		Water Ingestion Rate (L/day)		Sediment Ingestion Rate (kg/day)		Home Range (acres) <sup>(3)</sup>		
	Avg.	Min.	Max.	Avg.	Conserv.	Avg.	Conserv.	Avg.	Conserv.	Avg.	Min.	Max.
<b>Potential Test Species<sup>(1)</sup></b>												
Rat	0.35	NA	NA	NA		NA		NA		NA		
Mouse	0.03	NA	NA	NA		NA		NA		NA		
Rabbit	3.8	NA	NA	NA		NA		NA		NA		
Mink	1	NA	NA	NA		NA		NA		NA		
<b>Surrogate Wildlife Species<sup>(2)</sup></b>												
Raccoon	6.865	5.34	8.86	0.3347	0.4128	0.5664	0.5698	0.0315	0.038803	386	267	504.1
Belted Kingfisher	152	136	170	0.0689	0.0758	0.0167	0.0187	0.0014	0.001516	2.86	0.96	5.399

**Notes:**

See Attachment 2 for the source of calculation of the exposure factors

NA - Not Applicable

1 - Sample et al., 1996 (only one value was provided so it was placed in the average column)

2 - U.S. EPA, 1993b for all factors except soil ingestion; Beyer (1993) or Talmage and Walton (in press) for soil ingestion rates

3 - Home range for the kingfisher is presented in km of shoreline.



# Navy Ecological Risk Assessment Tiered Approach

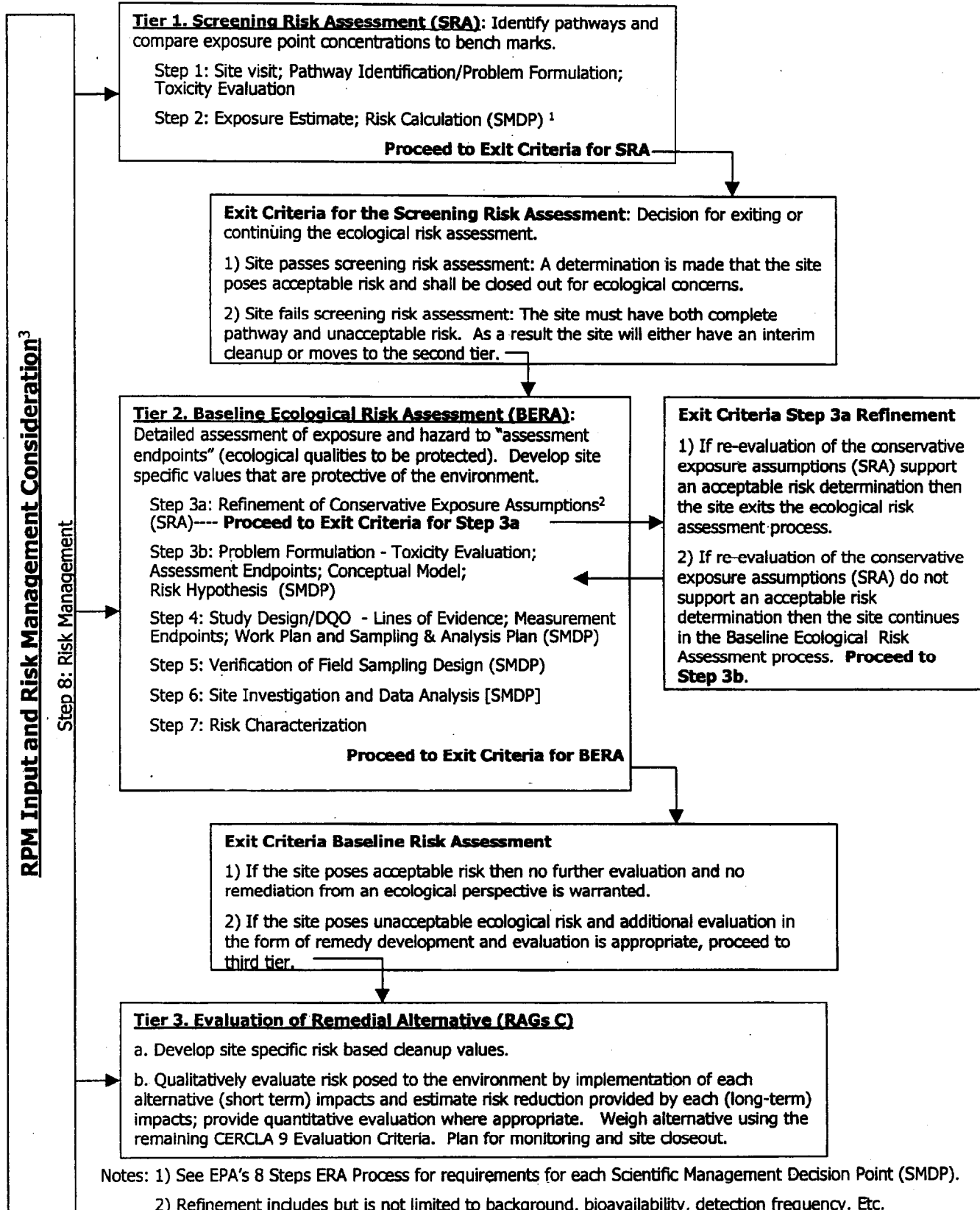


FIGURE 1-1

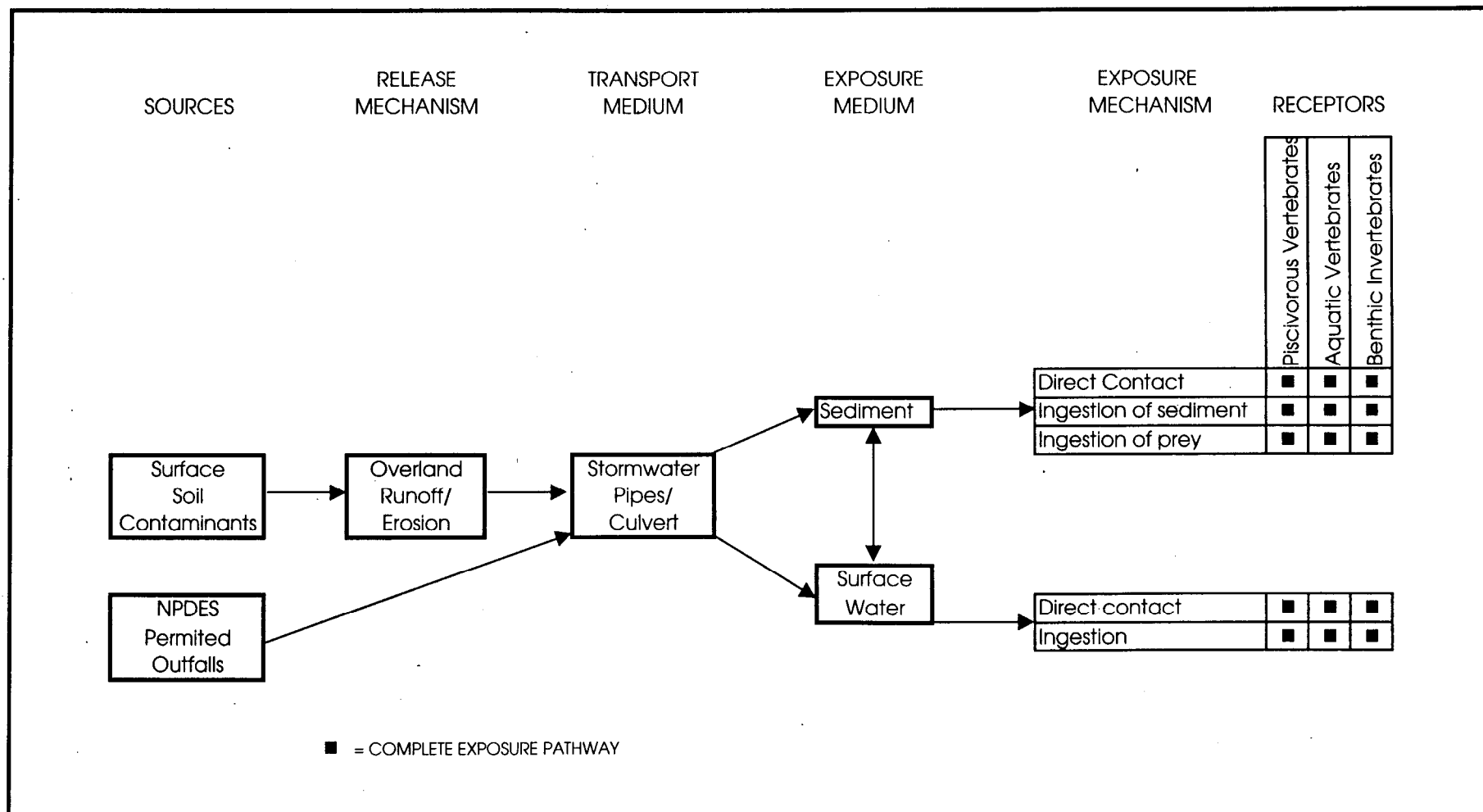


FIGURE 1-2

**SITE 17**  
**ECOLOGICAL CONCEPTUAL SITE MODEL**  
**NTC GREAT LAKES, ILLINOIS**

## ATTACHMENT 1

### RECEPTOR PROFILES NTC GREAT LAKES, ILLINOIS

The following sections present the receptor profiles for the raccoon, and belted kingfisher. The majority of the information for the profiles was obtained from the Wildlife Exposure Factors Handbook (EPA, 1993). The data for the incidental soil ingestion rates were obtained from the Estimates of Soil Ingestion by Wildlife (Beyer, 1993). The exposure parameters that were selected for this SERA work plan are based on animals collected in or near southern Illinois, when available.

The food and water ingestion rate are presented in g/g (of body weight)-day on a wet weight basis. The home ranges for all species are presented in hectares in EPA (1993), but were converted to acres in this work plan by multiplying the number of hectares by 2.471. The only exception is the kingfisher's range, which is presented in km of shoreline. Also note that the estimated percent of soil in the diets are listed in dry weight, while the other exposure factors are in wet weight. The soil dry weight was not converted to a wet weight in this work plan because the percent moisture of the soils is not known. Also, incidental soil ingestion is only a small portion of the overall diet (2.0 to 13 percent).

The attached table presents the calculation of the exposure parameters. Note that in this table the ingestion rates in kg/day (or L/day) for the conservative scenario was calculated by multiply the maximum ingestion rate in g/g-day by the average body weight, while the ingestion rates in kg/day (or L/day) for the average scenario was calculated by multiplying the average ingestion rate in g/g-day by the average body weight. Typically, a minimum body weight is used in the conservative models. However, using the minimum body weight to calculate the maximum ingestion rate sometimes causes the conservative ingestion rate to be lower than the average ingestion rate. Therefore, the average body weight was selected to ensure that the ingestion rate for the conservative scenario was higher than the ingestion rate for the average scenario. The minimum body weight will be used in the dose equation for the conservative scenario. The only exceptions to this were for the food ingestion rate for the raccoon, and the water ingestion rate for the kingfisher. Because only one ingestion rate was available, the maximum body weights were used to calculate the conservative ingestion rates and the average body weights were used to calculate the average ingestion rates.

**Raccoon (*Procyon lotor*)**

Raccoons are found near virtually every aquatic habitat, particularly in hardwood swamps, mangroves, floodplain forests, and freshwater and saltwater marshes. They are also common in suburban residential areas. They use surface waters for both drinking and foraging. They feed primarily on fleshy fruits, nuts, acorns, and corn, but also eat grains, insects, frogs, crayfish, eggs, and virtually any animal and vegetable matter.

The adult body weights based on data from Illinois, range from 5.34 to 8.86 kg, with an average of 6.865 kg. The average food ingestion rate of 0.3347 kg/day was calculated using the average body weight and the following equation from EPA (1993):

$$FI = (0.0687) (BW^{0.822})$$

Where: FI = Food ingestion rate (kg/day)

BW = Body weight in kg

The range of water ingestion rates is listed as 0.082 to 0.083 g/g-day. The incidental soil ingestion rate is calculated by multiplying the ingestion rate by the percentage of soil that is incidentally ingestion (0.094), as presented in Beyer (1993).

Based on data from Michigan, home range sizes for the raccoon range from 266.9 to 504.1 acres for an average home range of 385.5 acres.

**Belted Kingfisher (*Ceryle alcyon*)**

Belted kingfishers are typically found along rivers, streams, and the edges of lakes and ponds. They are also common along seacoasts and estuaries. They prefer water that is free of thick vegetation and overhanging trees that obscure the view of the water. Because kingfishers eat primarily fish that swim near the surface or in shallow water, they require relatively clear water to see and catch their prey. Although kingfishers feed predominantly on fish, they have been known to consume crayfish, crabs, mussels, lizards, frogs, toads, small snakes, turtles, insects, salamanders, newts, young birds, mice, and berries.

Based on data from Michigan, Pennsylvania, Ohio, and Minnesota, the adult body weights range from 0.136 to 0.170 kg, with an average of 0.152 kg. The listed food ingestion rates, based on data from

Michigan, range from 0.41 to 0.5 g/g-day. The water ingestion rate is estimated as 0.11 g/g-day. The incidental soil ingestion rate was calculated by multiplying the ingestion rate by the percentage of soil that is incidentally ingested (2 percent), based on the mallard data presented in Beyer (1993).

The home range for the kingfisher ranges from 0.39 to 2.185 km of shoreline, based on data from streams in Pennsylvania and Ohio.

## REFERENCES

Beyer, N., E. Connor, and S. Gerould. 1993. Estimates of Soil Ingestion by Wildlife. Patuxent Wildlife Research Center, Laurel, MD.

EPA, 1993. Wildlife Exposure Factors Handbook. U.S. Environmental Protection Agency. Office of Research and Development. Washington, D.C. December 1993. EPA/600/R-93/187a.

# ATTACHMENT 2

NTC Great Lakes

QAPP

Section: Appendix II-Site 17 Eco RA

Revision: 0

Date: July 2001

## CALCULATION OF EXPOSURE PARAMETERS FOR WILDLIFE RECEPTORS NTC GREAT LAKES, ILLINOIS

Exposure Parameters	Raccoon		Belted Kingfisher
Body Weights (g)	7090	6160	150
	7140	6440	136
	7600	5340	158
	6000	5620	147
	6400	8860	148
	7740	7560	170
	6560	7600	
	<b>Minimum</b>	<b>5340</b>	<b>136</b>
	<b>Maximum</b>	<b>8860</b>	<b>170</b>
	<b>Average</b>	<b>6865</b>	<b>152</b>
Food Ingestion Rate (g/g-day)	NA <sup>(1)</sup>		0.5
			0.41
	<b>Minimum</b>		<b>0.41</b>
	<b>Maximum</b>		<b>0.5</b>
	<b>Average</b>		<b>0.455</b>
Food Ingestion Rate (kg/day)			
	<b>Conservative</b>	<b>0.4128</b>	<b>0.0758</b>
	<b>Average</b>	<b>0.3347</b>	<b>0.0689</b>
Water Ingestion Rate (g/g-day)	0.082	0.083	0.11
	<b>Minimum</b>	<b>0.082</b>	<b>0.11</b>
	<b>Maximum</b>	<b>0.083</b>	<b>0.11</b>
	<b>Average</b>	<b>0.083</b>	<b>0.110</b>
Water Ingestion Rate (L/day)			
	<b>Conservative</b>	<b>0.5698</b>	<b>0.0187</b>
	<b>Average</b>	<b>0.5664</b>	<b>0.0167</b>
Home Range (Ha) <sup>(2)</sup>	204	108	2.185
			1.028
			1.03
			0.39
	<b>Minimum (acres)<sup>(2)</sup></b>	<b>267</b>	<b>0.39</b>
	<b>Maximum (acres)<sup>(2)</sup></b>	<b>504</b>	<b>2.19</b>
	<b>Average (acres)<sup>(2)</sup></b>	<b>385</b>	<b>1.16</b>

### Notes:

Source of data is U.S. EPA, 1993b

1 - Food Ingestion Rate (kg/day) for the raccoon was calculated using the following equation:

$$FI = (0.0687)(BW^{0.822}), \text{ where } FI = \text{Food Ingestion Rate (kg/day)} \text{ and } BW = \text{Body Weight (kg)}.$$

2 - Home range for the kingfisher is presented in km of shoreline.

Ingestion Rates (kg/day or L/day) (if more than 1 ingestion rate is available)

- Conservative value = Max Ingestion Rate (g/g-day)\* Avg. Body Weight

- Average value = Avg. Ingestion Rate (g/g-day)\*Avg. Body Weight

Ingestion Rates (L/day) (if only 1 ingestion rate is available)

- Conservative value = Ingestion Rate (g/g-day)\* Max. Body Weight

- Average value = Ingestion Rate (g/g-day)\*Avg. Body Weight

## **APPENDIX III**

### **DATA QUALITY OBJECTIVES**



### **III.1 SITE 7 RTC SILK SCREENING SHOP**

**DATA QUALITY OBJECTIVES SUMMARY**  
**SITE 7 REMEDIAL INVESTIGATION/RISK ASSESSMENT**  
**01-30-01 TO 03-01-01**

**DQO MTG DATES (AND ATTENDEES):**

01-30-01 (Davis, Jackman, Phipps, Bernhardt, Johnston)  
02-06-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)  
02-08-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)  
03-01-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)

**DQO STEP 1. STATE THE PROBLEM**

*Regulatory Context:*

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendment and Reauthorization Act (SARA). The results of this investigation will be used to assess whether Site 7 should be placed on the National Priority List.

*Regulatory Documents, ARARs, and other pertinent documents:*

CERCLA/SARA regulations  
Risk Assessment Guidance for Superfund  
U.S. EPA Region 9 Preliminary Remediation Goals (PRGs)  
U.S. EPA Region 3 PRGs  
Site 7 Historical information  
Previous Investigation Reports for Site 7  
U.S. Navy policies/guidance (e.g., background policy and guidance, land use controls policy)  
There are BG results associated with NPL sites upstream of Pettibone Creek and in the Site Inspection Report.  
Region 5 CERCLA QAPP Requirements.  
EPA Region 5 Data validation guidelines.  
Illinois Tiered Assessment Criteria Objective (TACO) Regulations plus others

*Primary Decision Maker:*

For TtNUS the decision maker is Bob Davis.

For the Navy the decision maker is Anthony Robinson (Navy Remedial Project Manager). However, all investigative work must ultimately be approved by the Illinois EPA.

Regional EPA will have review and comment privileges but not approval authority.

*Planning Team:*

TtNUS Project Manager/Technical Lead: Bob Davis

TtNUS Chemist/DQO Facilitator: Tom Johnston

TtNUS Project Chemist: Angie Scheetz

TtNUS Human Health Risk Assessor: Tom Jackman

TtNUS Ecological Risk Assessor: Aaron Bernhardt

TtNUS Project Geologist: Bob Balkovec

Navy Remedial Project Manager: Anthony Robinson (not available at TtNUS internal mtgs)

U.S. EPA Region 5: Not involved unless political or other issues require their involvement.

Illinois Environmental Protection Agency: Brian A. Conrath

*Land Use:*

Historical use: industrial/commercial (discharge of silk screen process wastes).

Current land use: industrial/commercial

Future projected land use is: Drill hall, most likely

*Assumption:*

Projected land use will be in effect for at least 50 years. A purchase of land east of Site 7 is planned. It is not known whether the purchase will occur prior to the field work for this effort. Failure to implement the purchase will not prevent access to that area. Bob Davis has identified points of contact for gaining access. Access may have to be gained through the County, the railroad and the golf course.

*Site History:*

The silk screening shop is located in Building 1212. Between 1965 and 1985 wastewater from the silk screening shop wash water booth drained directly onto the unpaved ground just outside of Building 1212. Known chemicals used in the silk screening are paints, inks, water- and oil-based lacquers, enamels, mineral spirits, acetone, thinners, and photographic emulsions. There was a 3' by 15' (approximate) east-west oriented stain adjacent to the northern outside wall of Building 1212 at the time of the IAS conducted in 1985. At the northeast corner of the building was a less obvious stain leading away from Building 1212, perpendicular to the northern outside wall. Together these formed an "L"-shaped stain that continued into the dirt road leading behind the building. This L-shaped area is the area of known contaminant releases. The IAS reports that pools of water formed in this area during heavy discharge

periods. The pooled water would infiltrate the soil, be washed away by precipitation, or evaporate. Upwards of 20,000 gallons of process waste may have been released in this area. However, silk screen wastes are no longer released to the environment. Building 1212 footers appear to extend to about 6.5' below ground surface, so contaminants would have to have permeated to at least that depth before migrating underneath the building.

Soil in this area is classified in the IAS as slowly to moderately permeable silty loam or filled or developed land. No site-specific soil permeability information is available. As recently as November 1991, the grounds outside Building 1212 were covered with gravel. The Building 1212 exterior grounds are currently covered with asphalt and the asphalted area serves as a parking lot. Contaminant migration potential is thought to be aided by drains located near Building 1212 that connect to storm sewers leading underneath Ohio Street to the east.

Two 500 gallon above-ground storage tanks (ASTs) were once located about 35 feet northwest of the northeast corner of Building 1212. One was used for diesel fuel storage; the other was used for gasoline storage. A petrochemical release from one of those tanks in 1992 is documented. It isn't clear from which tank the release occurred. Contaminated soil was excavated at and around the release point out to clean soil, then 6" beyond. The excavation was extended to a point 6" beyond the beginning of clean soil at which point green goo of unknown nature and extent was encountered. The goo was not remediated but the excavation was filled in with clean material. A WWII vintage gasoline station might also have been located at Site 7. Underground storage tanks may be located in the north-central part of the existing parking lot.

Water-bearing zones described as glacial aquifers lie about 15 to 50 feet below the ground surface. Traversing east to west across the Training Center, depth to groundwater ranges from about 2.5 feet to 5 feet bgs. Shallow groundwater in this area is described as not being used as a drinking water source (Technical Memo, Nov. 1991, Sec. 2.2.4.4). The relatively impervious surface material suggests that direct infiltration to the aquifers is not a primary migration pathway other than for pooled liquid collecting during large chemical releases or storm events. Instead, the IAS reported that the primary migration route appears to be via storm water runoff, through storm sewers to Pettibone Creek, with subsequent discharge to Lake Michigan. Overland flow was also identified as a potential migration pathway.

A 30' by 95' (approximate) rectangular subterranean concrete vault for steam lines is oriented in a north-south direction approximately 15 feet west of Ohio Street and 50 north of the northeast corner of Bldg 1212. Just west and adjacent to the vault is a 25' by 95' (approximate) rectangular fenced area that is the location of at least two debris piles. One, approximately circular debris pile located at the center of the

eastern fence line, is about 8 feet in diameter. The other debris pile, located at the north end of the fenced area is irregular in shape and covers the northernmost end (approximately 20%) of the fenced area. North and adjacent to these two rectangular areas is 28' by 48' (approximate) rectangular Bldg 1209 oriented in an east-west position. Just west of and adjacent to the northwest fence line is another large debris pile about 20' by 30' in size and approximately oval in shape.

The area east of Site 7 is to be purchased at an unknown date. The area is vegetated with grass, trees and shrubs, thus providing habitat for small avian and terrestrial species. There is a large (approximately 10' deep) depression at the location of Site 7 outfalls and other outfalls indicating significant erosion of the associated soils. Two pairs of railroad tracks used to run north-south along the Training Center boundary, but only one pair of tracks remains.

Potential ecological receptors include organisms such as fish that live in the pooling area east of Site 7, in Pettibone Creek, the harbor, and Lake Michigan. Human receptors include personnel living in Recruit Training Center camps, although the limited free time allocated to these personnel would significantly limit their opportunities for exposure.

#### *Historical Data*

A site history was passed out to the planning team during the DQO kick-off meeting. Additional data were summarized later and presented to the team. Two soil samples were collected from each of three separate locations in the stained area to a depth of 2 feet. The results were reported in 1991 Technical Memorandum (NEESA 21-011, Volume 2A). The intent of the investigation was to determine whether contaminants were present, and if so, to delineate limited horizontal and vertical extent of contamination. The samples were analyzed for priority pollutant VOCs, silver, chromium (total), cadmium, and lead. The results indicated detectable concentrations of cadmium, chromium, lead, acetone, toluene and methylene chloride, although the latter three compounds were suspected to have been laboratory contaminants. Only lead concentrations were interpreted as being greater than typical background concentrations. Hexane was tentatively identified as a contaminant at concentrations ranging from 8 ug/kg to 10 ug/kg. No other VOCs were detected. Hexane was suspected to have been a laboratory contaminant because the concentrations were described as being "very low" and because hexane was detected at similar concentrations in other samples (Technical Memo, Nov.1991).

#### *Project Scope:*

This project is concerned only with risks and contamination in Site 7 soils and ground water. There is no surface water body at or immediately adjacent to Site 7 but Site 7 runoff may have migrated to Pettibone Creek located several hundred feet east of Site 7. This eliminates surface water and sediment from

consideration with the exception of potential groundwater migration to the creek. Concerns are risks to humans and ecological receptors and extent of contamination. Pettibone Creek will be evaluated under Site 17.

*Problem Statement:*

Releases of photographic/silk screening chemicals and petroleum hydrocarbons have been documented at Site 7. The Navy intends to raze existing buildings (e.g., Bldg 1200) adjacent to Site 7, and to construct a military drill hall at Site 7, for future boot camp recruits. The Navy wants to be assured that soils will not pose unacceptable risks to construction workers, maintenance workers or the future recruits. The Navy also plans to purchase the property to the east of Site 7 across Ohio Street and wants to know whether contaminants have migrated to that area (construction is not planned for that area). However, the primary concern for this project is not the extent of contamination as much as the nature of the contaminants.

*Assumption:*

The most likely future land use is a military drill hall for Navy recruits. The most likely receptor is a construction worker who might excavate into the subsurface soil and into the groundwater table. However, a residential risk assessment for nearby residents must be conducted as a "benchmark" to obtain perspective on any other risk assessment scenarios. The residential risk assessment may also support future site decisions concerning suitability for transfer of the land for residential or other use. Therefore, the analyte detection limits have to be low enough to meet residential risk screening levels. Navy recruits were considered but their exposure is assumed to be negligible because of the physical characteristics of the site and their limited duration at the Base.

*Concern:*

The concern is three-fold:

1. Current and future health risk to:
  - potential construction worker
  - potential maintenance worker
  - nearby military residents
  - Future potential civilian resident at Site 7
2. Current and future potential ecological risk, from exposure to soil and shallow groundwater at Site 7.
3. A secondary need to obtain information concerning the extent of contamination in Site 7 soil and shallow groundwater.

*Assumptions:*

- There is no habitat for ecological receptors west of Ohio Street because the site is currently paved. Furthermore, future construction would subject the site to a major disruption of any habitat.
- Just east of Ohio Street (east of Site 7) is vegetated and is habitat for small mammals and birds.
- The final RI/RA report must be written and approved prior to the start of any razing at Site 7.

*Risk Drivers Summary:*

HHRA: Construction worker

Maintenance worker

Nearby military residents (inhalation and groundwater exposure pathways)

Future potential civilian residents

ERA: No receptors at Site 7 proper

Small mammals and birds to the east of Ohio Street

**DQO STEP 2: STATE THE DECISION**

*Principal Study Question:*

- Is risk at Site 7 from exposure to any environmental medium unacceptable to the future Navy recruits or nearby residents (current or future)?
- Is risk or will risk from exposure to any medium east of Site 7 pose an unacceptable risk to ecological receptors?

*Secondary Questions:*

- Are Site 7 contaminants migrating or have Site 7 contaminants migrated to the east of Site 7?

*Alternative actions:*

- Conduct a Feasibility Study (FS) to evaluate remedial options
- Conduct additional RI sampling/monitoring
- Implement a removal action (under circumstances of extreme contamination)
- Take no further action (NFA)

**Decision Statement:**

**Note:** An interim action may be recommended at any time.

- a. Determine whether risk to future Navy recruits, residents or maintenance/construction workers (whichever receptor is the most limiting receptor) is unacceptable at Site 7. If risk is unacceptable, then recommend an FS. If risk is not unacceptable under the most conservative risk scenario, take no further action for protecting recruits.
- b. Determine whether current or future unacceptable ecological risk exists due to Site 7 contaminants. If risk is unacceptable then conduct an FS, otherwise take no further action.
- c. Determine whether areas of unacceptable contamination are adequately bounded by having bracketed the estimated contamination boundary by clean and dirty samples. If the contamination is not adequately bounded, continue sampling to bound the contamination.

### DQO STEP 3: IDENTIFY THE DECISION INPUTS

#### *Assumption:*

- If contamination could migrate from soils to groundwater, then unacceptable levels of contamination would be expected in the groundwater. Therefore, groundwater protection standards for migration of contaminants from soil to groundwater will not be used. Instead, direct monitoring of the groundwater will be conducted.
- Site 17 (Pettibone Creek) is an integrator of contaminants from Site 7 and sampling of sediments/surface water at Site 17 should provide indications of contaminant migration from Site 7. Sampling will be conducted at Site 17 concurrently with Site 7 sampling.

#### *Decision Inputs:*

**Note:** Original sampling and analyses included only priority pollutant VOCs, silver, chromium (total), cadmium, and lead, based on the types of materials potentially discharged in the silk screening shop wash water.

- PAHs, PCBs, pesticides, herbicides, dioxins, furans and explosives are not analytes of interest based on Site 7 operational history and limited data from Site 7. The following chemicals are of interest:
  - EPA Contract Laboratory Program (CLP) Target Analyte List (TAL) metals. Total cyanide will not be analyzed. Hexavalent chromium also will not be analyzed because historical data for total chromium do not show any significant risk.



- CLP Target Compound List (TCL), version 4.2, semivolatile organic compounds (SVOCs).
- CLP TCL, version 4.2, volatile organic chemicals (VOCs) plus ethyl acetate and ethyl alcohol.
- Monitored Natural Attenuation (MNA) parameters [alkalinity, TOC, dissolved iron, dissolved Mn, chloride, nitrate, nitrite, orthophosphate, sulfate, dissolved sulfide, methane, ethane, ethene (methane, ethane and ethene are analyzed only if chlorinated VOCs are detected?)]

The actual analyte list will be presented in the QAPP.

**Note:** We will generate a table in the QAPP showing each parameter or parameter fraction (e.g., SVOC), the media in which data on the parameter/fraction will be collected, and the rationale(s) for collecting information on that parameter in the indicated medium. The following rationales may be selected: MNA evaluation, HHRA, ERA, and extent of contamination.

- Analytical methods: The laboratory methods will be SW-846 methods because lower detection limits can be achieved more easily with those methods than with CLP methods. We anticipate having to achieve low detection limits for the risk assessment. Field methods will be PID for organics, and other field instruments for other field measurements. We will use EnCore samplers for VOCs in soil. Water will be collected in VOC vials, as usual.
- Risk scenarios for construction worker, maintenance worker, future boot camp recruit, residents, and ecological receptors.

*Assumptions:*

- Other data and parameters for which data will be needed: (both soil and GW unless otherwise indicated):
  - Historical well water survey data (GW)
  - Background analyte concentrations (organic, inorganic)
  - Grain size (soil)
  - Cation exchange capacity (soil)
  - pH
  - TOC
  - Turbidity (GW)
  - Specific conductance (GW)

- Dissolved oxygen (GW)
  - ORP (GW)
  - Hydraulic conductivity (soil)
  - Temperature (GW)
- Water levels to generate groundwater table elevations/potentiometric maps
  - Pump or slug test to characterize the aquifer(s)
  - Action Levels for risk, and background exceedance in soil and groundwater.

**Note:** Filtered groundwater samples will be collected in addition to unfiltered samples at sampling locations where the turbidity can not be reduced to less than 10 NTU with reasonable effort.

Assumption: Disposable sampling equipment will be used as much as possible.

QC Type	Equipment	Frequency
Rinsate Blank	Cutting Shoe	1 per sampling event
Rinsate Blank	Disposable trowel	1 per lot of trowels
Rinsate Blank	Acetate liner	1 per lot of liners
Duplicates	NA	1 per 10 field samples
MS/MSD	NA	1 per 20 field samples
Ambient Condition Blanks	NA	None expected but may be collected at FOL discretion based on field conditions
Source water blank	NA	One per field event
Temperature Blank	NA	One per cooler
Trip blanks (VOCs only)	NA	One per cooler

*Data Use:*

Non-detects evaluated for risk will be substituted with half the detection limit.

If any analyte is all non-detect, we will exclude that analyte from the COPC list.

*QC Samples:*

Try to collect duplicate samples at locations where contamination is expected. This will minimize potential for obtaining non-detects, which do not support precision estimates. Collecting replicates from regions of undetectable contamination does not provide useful estimates of variability.

#### **DQO STEP 4: ESTABLISH THE STUDY BOUNDARIES**

##### *Assumptions:*

- Site 7 is the L-shaped stained area adjacent to Building 1212. The Site 7 study area includes Site 7 and extends downstream across Ohio Street toward the golf course to the east.
- This is an industrial area. If it were converted to residential use, one would expect the land use to emulate surrounding residential land use. Residential lot sizes range from approximately ¼ acre in size to several acres, so the exposure unit size could reasonably be set at any size up to about 2 acres. It is assumed that lots greater than two acres in size are not numerous. Matching the lot size to a realistic estimate prevents the potential for underestimating or overestimating risk for actual receptors.
- Building 1212 and surrounding asphalt ground cover will be considered to have been removed for future human health risk scenarios, which will create a potential exposure pathway to soils.
- An upgradient groundwater well will be useful to obtain perspective and will serve to provide background concentrations if they are not available by other means.
- Site 7 groundwater is expected to be relatively homogeneous but the greatest probability for demonstrating groundwater impact will come from sampling near the most contaminated soil.
- Navy recruits and current and future residents drink public utility water and do not drink groundwater from Site 7.

##### **Temporal considerations**

##### *Assumptions:*

Conditions today will reflect future conditions because no new releases of significance are expected and the site is old enough to have stabilized with respect to contaminant transport rates. Therefore, no modeling will be required.

##### *Exposure Unit:*

### Extent Considerations:

It is believed that the building foundation wall poses an impediment to contaminant migration underneath the building, although the sampling program should support the testing of this assumption. Two boundaries have been drawn for Site 7. One is to support the initial sampling round and does not include sampling underneath the building. The other is an expansion of the Site 7 area to include a portion of the soil under the Building 1212.

### Media:

- Groundwater anywhere on site to a depth of 10 feet is of interest for dermal contact considerations but not for human consumption.
- Asphalt and gravel layer under asphalt will not be sampled.
- The entire subsurface interval will be represented with a single sample composited over the entire core length except for VOC analyses.

### Risk Considerations:

The exposure unit (EU) is the entire Site 7 study area. The entire Site 7 study area is about ¼ acre in size so the entire study area will be the exposure unit. If the study area is expanded, the exposure unit may also be expanded. The decisions to be made will correspond to an EU that is ¼ acre in area down to a depth as shown in the following table.

Receptor	Depth Groundwater	Surface Soil	Subsurface Soil
Maintenance Worker	NA	0' to 1'	NA
Construction Worker	0' to 10'	0' to 1'	1' to 10'
Nearby Military Residents	NA	0' to 1'	NA
Future potential civilian resident	NA	0' to 1'	NA

- ~~Surface Water~~ (eliminated because monitoring program does not include it)
- ~~Sediment~~ (eliminated because monitoring program does not include it)
- Air (eliminated because no current emission sources were identified)

### DQO STEP 5: STATE THE DECISION RULES:

Assumption: An interim removal action (IRA) may be conducted at any time.

It is easiest to present the decision rules in flow chart form. Flow charts for the decision rules were developed and transferred to the Draft QAPP. The risk evaluation is preceded by COPC selection. If no COPCs are identified, all investigative action stops with the generation of a final report finding no unacceptable risk. If at least one COPC is identified, the extent of contamination and the risk will be evaluated. If risk is unacceptable, corrective action will be recommended with the possible inclusion of institutional controls. If risk is not unacceptable, no further investigative action will take place. The extent of contamination will be determined only if at least one COPC is identified. Extent of contamination may not be well defined because establishing the extent of contamination is a secondary concern. However, the initial data used for risk evaluation should provide clear indications as to whether contamination of concern exists and some indication as to the extent of contamination.

The trigger (action levels) for recommending a feasibility study is an exceedance of either a human health incremental lifetime cancer risk of  $1E-4$  or a hazard index of 1.0.

Establishing an action level for implementing institutional controls was considered, but it was thought better to leave that decision to professional judgment. Instead of establishing a numerical action level, allowance has been made in the decision logic flow diagrams.

Based on past soil analyses reported in 1993 (Tech memo), it was thought that an interim action is unlikely. Therefore, a decision diamond for interim action is not included in the decision flow charts. However, an interim action could be implemented at any time to deal with perceived extreme contamination conditions or to expeditiously remove some or all of the site contaminants, for example, for political reasons.

The 95% UCL on the HI will be used when evaluating non-cancer risk.

When bounding the extent of contamination, the midpoint between the contours representing samples with concentrations exceeding the action level and the samples with concentrations less than action level will be selected as the boundary of contamination.

#### **DQO STEP 6: ESTABLISH DECISION PERFORMANCE SPECIFICATIONS**

The group discussed the types of errors that could be made:

- A. Unknowingly consider an unacceptably contaminated site to pose no unacceptable risk.
- B. Unknowingly take a corrective action at a site that poses no unacceptable risk.

The consequences of error A were identified as:

- Potential adverse effect to a receptor
- Potentially costly liability
- Potential loss of credibility of the Navy to outside parties
- Potential political concerns generated from making this error

The consequences of error B were considered less egregious:

- Navy project mgr loss of credibility internally to the Navy
- Spending money to take corrective action when corrective action is really not warranted

Error A was considered to be the most egregious error.

The null hypothesis was established as:

H0 = The site poses an unacceptable risk

From this the alternative hypothesis was established:

HA = The site does not pose an unacceptable risk

A discussion ensued concerning the number of samples necessary to support the decision making process and how the following factors affect the number of samples:

- Delta (the smallest detectable difference between the site mean and the action level)
- Sigma (the standard deviation of the site data from a single population)
- Alpha (the tolerance, in terms of probability, for making error A)
- Beta (the tolerance, in terms of probability, for making error B)

Error tolerances were not quantified at this step because there was a sense that a non-statistical sampling plan might be used at this site. The desire to use non-statistical sampling is based primarily on:

- the need to establish the nature and extent of contamination
- the willingness to accept an overestimate of risk (risks are not expected to be significant, based on historical data)
- and the relatively small size of the site.

## **DQO STEP 7: OPTIMIZE THE DESIGN**

The strengths and weaknesses of the following sampling strategies were discussed:

- Biased sampling
- Simple random sampling
- Stratified random sampling
- Grid sampling

The limited applicability or inapplicability of statistics to data collected under a biased sampling scheme was also discussed.

The project goals were reviewed:

- Evaluate risk
- Evaluate nature and extent of contamination (secondary concern)
- Establish groundwater levels and flow direction (supporting information)

### **Sampling constraints**

- The subsurface is riddled with utility lines which could pose an impediment to sampling
- Asphalt covers at least half of the site
- The ditch is the primary contaminant transport conduit to the east of Site 7.
- GW levels must be established in two directions because no information is currently available on GW flow direction.
- Wells may only be installed on Navy property. The Navy prefers that only temporary wells be used (in lieu of permanent wells)
- VOCs must be collected from areas of soil cores that yield the greatest PID or FID readings.
- Duplicate VOC samples must be collected as close together in a core as feasible.

It was decided that the layout of the site and the needs of the piezometer and well installation would provide several bore holes covering the site. Adding more soil borings to acquire random samples was potentially overkill as far as the number of samples to be collected. The limitation on statistical calculations from using primarily biased sampling was again acknowledged and evaluated.

The group decided that a statistical sampling design will not be practical for this site. Instead, a conservative sampling approach using biased samples would provide the greatest value, even though site contaminant concentrations were likely to be overestimated. Several topics were considered when arriving at this conclusion:

1. Historical data is somewhat limited, so revisiting the original soil sample strategy with biased samples just to determine whether contaminants are present at Site 7 is warranted.
2. The presence of the ditch east of Ohio St. may require some sampling biased toward (actually *in*) the ditch because the ditch is the primary conduit for contaminant transport into the area east of Site 7 and the extent of contamination is also a concern.
3. Water levels must be determined, which is most efficiently accomplished by installing piezometers. At least six piezometers are required to establish water levels and hence, groundwater flow in more than one direction.
4. To save money, it is desirable to use the piezometer borings for soil sample collection. The small size of the site will result in the piezometer borings providing good spatial coverage.
5. At least three wells must be installed to monitor upgradient and downgradient groundwater contamination.

With all of these constraints, it was recognized that the measured contaminant concentrations are likely to overestimate the site contaminant concentrations as a whole, especially for the soil samples collected from within the ditch. Given the low levels of contaminants reported in 1993 (Tech memo), this was considered not to be a significant concern. Therefore, the site data will be analyzed using the usual statistical techniques with no allowance for discounting data that exceed action levels because of bias unless additional data are collected to estimate the degree and direction of bias.



**Draft Analyte List.**

Parameter	Environmental Medium			Intended Data Use
	GW	SS	SB	
Contract Laboratory Program (CLP) Target Compound List (TCL) Volatile Organic Compounds (VOCs)	X	X	X	
CLP TCL Semivolatile Organic Compounds (SVOCs)	X	X	X	
CLP Target Analyte List (TAL) Metals	X	X	X	
Cyanide (total)	X	X	X	
Ethyl Acetate, Ethyl Alcohol and Isopropyl Alcohol	X	X	X	
Isopropyl Acetate and n-Propyl Acetate				
Total Petroleum Hydrocarbons (TPH)				
Diesel Range Organics (DRO)				
Gasoline Range Organics (GRO)				
Volatile Fatty Acids (VFAs): Pyruvic, Acetic, Propionic, Butyric, Lactic				
Total Organic Carbon (TOC)	X	X	X	
MNA Parameters				
Toxicity Characteristic Leaching Procedure (TCLP) organics and inorganics				
Grain Size (f)		X	X	
Cation Exchange Capacity (CEC) (f)				
pH (f)	X			
Turbidity (f)	X			
Specific Conductance (f)	X			
Dissolved Oxygen (f)	X			
Hydraulic Conductivity (f)	X			
Temperature (f)	X			
Oxidation-Reduction Potential (ORP) (f)	X			

(f) Field analysis

GW – ground water

SS – surface soil

SB – subsurface soil

### **III.2 SITE 17 PETTIBONE CREEK AND BOAT BASIN**

**DATA QUALITY OBJECTIVES SUMMARY**  
**SITE 17 REMEDIAL INVESTIGATION/RISK ASSESSMENT**  
**DQO STEPS 1 THROUGH 4**  
**02-12-01 TO 03-01-01**

**DQO MTG DATES (AND ATTENDEES):**

02-12-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)  
02-15-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)  
02-21-01 (Steve Ruffing, Andy Kendrick, Mark Perry, Davis, Johnston, Bernhardt)  
02-23-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)  
03-01-01 (Davis, Jackman, Phipps, Bernhardt, Johnston, Balkovec)

**DQO STEP 1. STATE THE PROBLEM**

*Regulatory Context:*

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendment and Reauthorization Act (SARA). The results of this investigation will be used to assess whether Site 17 should be placed on the National Priority List.

*Regulatory Documents, ARARs, and other pertinent documents:*

- CERCLA/SARA regulations
- Risk Assessment Guidance for Superfund
- U.S. EPA Region 9 Preliminary Remediation Goals (PRGs)
- U.S. EPA Region 3 PRGs
- Site 17 Historical information
- Previous Investigation Reports for Site 17
- U.S. Navy policies/guidance (e.g., background policy and guidance, land use controls policy)
- There are background results associated with NPL sites upstream of Pettibone Creek and in the Site Inspection Report.
- Region 5 CERCLA QAPP Requirements.
- EPA Region 5 Data validation guidelines.
- Illinois Tiered Assessment Criteria Objective (TACO) Regulations.

- Criteria of Lake Michigan Basin Water Quality Standards Subpart E of Part 302 apply to Pettibone Creek because the creek discharges directly into Lake Michigan. (Applicability of these criteria to groundwater will depend on whether groundwater is recharging the Pettibone Creek.)
- Evaluation of Illinois Sieved Stream Sediment Data, 1982-1995, Illinois Env. Protection Agency, Bureau of Water.

*Primary Decision Maker:*

For TtNUS the decision maker is Bob Davis.

For the Navy the decision maker is Anthony Robinson (Navy Remedial Project Manager). However, all investigative work must ultimately be approved by the Illinois EPA.

Regional EPA will have review and comment privileges but not approval authority.

*Planning Team:*

TtNUS Project Manager/Technical Lead: Bob Davis

TtNUS Chemist/DQO Facilitator: Tom Johnston

TtNUS Project Chemist: Angie Scheetz

TtNUS Human Health Risk Assessor: Tom Jackman

TtNUS Ecological Risk Assessor: Aaron Bernhardt

TtNUS Project Geologist: Bob Balkovec

Navy Remedial Project Manager: Anthony Robinson (not available at TtNUS internal mtgs)

U.S. EPA Region 5: Not involved unless political or other issues require their involvement.

Illinois Environmental Protection Agency: Brian A. Conrath

*Land Use:*

Historical use: commercial, recreational, natural ecological habitat.

Current land use: commercial, recreational, ecological habitat

Future projected land use is: commercial, recreational, ecological habitat but we must consider future potential residents in the risk assessment

*Assumption:*

Projected land use will be in effect for at least 50 years.

*Site History:*

Historical data are available on file. Most of the contamination was near the headwaters of the north and south branches of the creek. Photographs reveal that some limited flooding occurs in areas of low lying banks but the frequency of flooding is unknown. Potential or known contaminant sources include:

- Residential
- Road runoff
- More than 30 storm sewers
- Industrial discharges upstream of the Navy boundary at Pettibone Creek (one outfall is currently permitted under NPDES; more outfalls used to exist but have ceased operation and/or been removed)

A cursory review of the Illinois stream sediment report (1982-1995) that may be used to represent background concentrations for select inorganic and organic analytes shows that unsieved sample concentrations exceeded sieved sample concentrations about 50% of the time. This is contrary to conventional wisdom. It was noted that Pettibone Creek has a generally lesser organic carbon concentration than the background data.

The stream sediment report classifies sediment concentrations according to "Not Elevated," "Elevated," and "Highly Elevated." Evidently, "Not Elevated" is used as the action level to indicate concentrations exceeding background concentrations. Unsieved data are presented in Appendix I of the report.

*Project Scope:*

*Assumptions:*

- The most likely future land uses are recreational and general site drainage. Surrounding land continues to be military, industrial/commercial and military residential.
- The most likely human receptor is a recreational person, especially a child playing in and near the creek. However, a residential risk assessment for potential future residents must be conducted as a "benchmark" to obtain perspective on any other risk assessment scenarios. The residential risk assessment may also support future site decisions concerning suitability for transfer of the land for residential or other use. Therefore, the analyte detection limits have to be low enough to meet residential risk screening levels.
- The most likely ecological receptors are fish, benthic invertebrates, small mammals, birds, amphibians, and reptiles.

*Concern:*

The concern is three-fold:

1. Current and future health risk to:
  - Potential recreational receptors/current and future residents, especially adolescents from exposure to sediment/soil and surface water in Pettibone Creek. There is free access to the creek.
2. Current and future potential ecological risk from exposure to sediment and surface water at Site 17.
3. The extent of contamination at Site 17 between the headwaters of both the north and south branches to the downstream boat basin at the mouth of the main creek branch.

*Assumptions:*

Aquatic organisms inhabit the creek. These include fish, invertebrates, amphibians, and reptiles. Small mammals and birds are also likely to be exposed to creek contaminants when drinking water or ingesting prey from the creek.

*Risk Receptor Summary:*

HHRA: Recreationers/current and future nearby resident, especially children (primarily dermal contact and possible ingestion)

ERA: Fish, invertebrates, amphibians, reptiles, small mammals, and birds.

*Problem Description:*

Site 17 is a shallow creek with generally a moderate flow terminating in a boat basin. The boat basin was built in 1906. The creek generally exhibits water flow year round. Some low lying banks and small "flood plains" are found within the main banks of the creek. This site has received, or may have received, a variety of wastes from both upstream industries and local residents and workers. The upstream areas north of the Navy property line and adjacent to industrial sites have been cleaned up and we are told that additional releases to the creek from these industries should be insignificant. Nevertheless, there could be residual runoff into Pettibone Creek and one upstream outfall is still permitted under NPDES.

Previous sampling and analyses of sediments and water in the creek show that several contaminants of various classes have been detected at potentially unacceptable concentrations. Site historical data are available on file. The creek sometimes floods its immediate low lying banks within the main banks. The

main banks are generally steep and about 3 to 10 feet high. Flooding over top the higher banks is not known or expected to have occurred.

We must investigate the creek and boat basin to establish the nature and extent of contamination and to assess the risk to human and ecological receptors. The risk assessment should focus primarily on ecological receptors and recreational human receptors because residents and workers would have limited exposure to creek water and sediments. If either the creek or boat basin is unacceptably contaminated, we should recommend corrective action.

The boat basin was last dredged in 1972, so sediments currently present in the basin have basically accumulated over past 30 years. The material forming the boat basin bottom is not known, however, historical maps show contours of various depths that suggest a natural bottom (i.e., earth). A large depression was dredged at the end of Pettibone Creek near the boat basin spillway to serve as a sediment trap. Sediment can be removed relatively easily from this trap on a periodic basis. The Navy would be inclined to clean up the boat basin even if risks from exposure to it are marginally high because doing so would render the boat basin useful for docking small boats. This, in itself, has intrinsic value. That can more easily be cleaned out on a periodic basis.

## **DQO STEP 2: STATE THE DECISION**

### *Principal Study Questions:*

- Is risk at Site 17 from exposure to sediment and surface water unacceptable to the potential future resident/recreationer?
- Is risk or will risk from exposure to contamination in surface water or sediment at Site 17 pose an unacceptable risk to ecological receptors?
- What is the extent of contamination that poses an unacceptable risk?

### *Alternative actions:*

- Conduct a Feasibility Study (FS) to evaluate remedial options
- Conduct additional RI sampling/monitoring
- Implement a removal action (under circumstances of extreme contamination)
- Institute a fishing advisory
- Take no further action (NFA)

*Decision Statement:*

**Note:** An interim action or institutional controls may be recommended at any time.

**Note:** The risk evaluation for the boat basin might best be performed with a simple comparison of site data to screening criteria.

- a. Determine whether risk to potential future residents/recreationers is unacceptable at Site 17. If risk is unacceptable, then recommend an FS. If risk is not unacceptable, take no further action.
- b. Determine whether current or future unacceptable ecological risk exists due to Site 17 contaminants. If risk is unacceptable then conduct an FS, otherwise take no further action.
- c. Determine whether areas of unacceptable contamination are adequately bounded by having bracketed the estimated contamination boundary by clean and dirty samples. If the contamination is not adequately bounded, continue sampling to bound the contamination. If contamination is bounded, stop sampling.

**DQO STEP 3: IDENTIFY THE DECISION INPUTS**

*Assumption:*

Site 17 (Pettibone Creek) is an integrator of contaminants from Site 7 and other potential contaminant sources. Sampling of sediments/surface water at Site 17 should provide indications of contaminant migration from Site 7. Sampling is being conducted at Site 7 concurrently with Site 17 sampling.

*Decision Inputs:*

- The following chemicals are of interest:
  - Background analyte concentrations
  - EPA Contract Laboratory Program (CLP) Target Analyte List (TAL) metals (All samples).
  - CLP Target Compound List (TCL), semivolatile organic compounds (SVOCs) in selected samples (see note).
  - CLP TCL, version 4.2, volatile organic chemicals (VOCs) in selected samples (see note)
  - CLP Target Compound List (TCL), polychlorinated biphenyls (PCBs) (all samples)
  - CLP Target Compound List (TCL), polycyclic aromatic hydrocarbons (PAHs) in all samples (see note)
  - TOC: each sample



- AVS/SEM: representative no. of sediment samples (approximately 9 samples located over entire site and represented by three sand, silt, and clay grain sizes)
- Grain size: representative no. of sediment samples (approximately 9 samples, sand, silt, and clay)
- Toxicity testing on sediment (second phase of sampling only): representative no. of samples; should span a wide range of concentrations and grain sizes so an appropriate correlation can be made between chemical concentrations and toxicity.
- TCLP for waste disposal only
- pH: need good spatial coverage (representative sampling)
- Field-Lab grain size correlation (need 3 to 4 samples of clay and sand classes; 4 to 5 samples of silt class)
- Action Levels for risk, and background exceedance in soil and groundwater will be based on the Illinois stream sediment report (ISSR) for select inorganic and organic chemicals. We may have to supplement the ISSR because not all potential chemicals of concern are on the list. The state will also provide screening values on request for individual chemicals but they do not make their list of screening levels as a set.

The actual analyte list will be presented in the QAPP.

**Note:** The most current version of the TCL and TAL lists will be used because this project is basically starting fresh and we want to reflect the state of the science in our sampling and analyses, wherever feasible.

**Note:** We need to correlate laboratory grain size measurements to field grain size determination. Sediment/soil grain size will be classified as "sand," "silt," or "clay." It will be important to analyze in the laboratory a set of samples spanning as wide a range of field grain sizes as possible so the best chance of a correlation can be established. Grain size will be needed for toxicity testing.

We will probably analyze for the same contaminants but this should be evaluated further.

**Note:** Based on historical data, it is not necessary to analyze for the SVOCs, just the PAHs can be analyzed. However, 10% of the samples will be analyzed for SVOCs just as a check on the assumption that SVOCs are not primary contaminants.

**Note:** Based on historical data, it is not necessary to analyze for the VOCs and because VOCs would not be persistent in surface water and sediments unless contaminant concentrations are very high. We will best focus VOC analyses on a select number of samples. VOCs will be analyzed at a 10%, similar to SVOCs.

**Note:** We will generate a table in the QAPP showing each parameter or parameter fraction (e.g., SVOC), the media in which data on the parameter/fraction will be collected, and the rationale(s) for collecting information on that parameter in the indicated medium.

- Analytical methods: The laboratory methods will be SW-846 methods because lower detection limits can be achieved more easily with those methods than with CLP methods. We anticipate having to achieve low detection limits for the risk assessment. We will use glass jars for sediment sampling. Water for VOC analysis will be collected in VOC vials, as usual.
- Risk scenarios for potential future residents, recreational users (catching and eating fish), and ecological receptors.

**Note:** The risk evaluation for the boat basin will not be an actual risk assessment. Instead, it will be a simple comparison of site data to screening levels. This could mean that the boat basin would be dredged even though the actual risk to any receptor is not unacceptable. However, the Navy is willing to implement dredging of the boat basin on this basis because the value of using the boat basin for boating offsets any unnecessary cleanup costs.

**Note:** The Pettibone Creek risk assessment will be an actual risk assessment, as usual.

*Assumptions:*

- No useful background concentrations are available for organic chemicals. Sediment background data are available for inorganic contaminants.

*Data Use:*

Non-detects evaluated for risk will be substituted with half the detection limit.

If any analyte is non-detect in every sample, we will exclude that analyte from the COPC list. However, those analytes will be evaluated qualitatively in the risk assessment uncertainty analysis.

**QC Samples:**

Try to collect duplicate samples at locations where contamination is expected. This will minimize potential for obtaining non-detects, which do not support precision estimates. Collecting replicates from regions of undetectable contamination does not provide useful estimates of variability.

Assumption: Disposable sampling equipment will be used as much as possible.

QC Type	Equipment	Frequency
Rinsate Blank	Cutting Shoe	1 per sampling event
Rinsate Blank	Disposable trowel	1 per lot of trowels
Rinsate Blank	Acetate liner	1 per lot of liners
Duplicates	NA	1 per 10 field samples
MS/MSD	NA	1 per 20 field samples
Ambient Condition Blanks	NA	None expected but may be collected at FOL discretion based on field conditions
Source water blank	NA	One per field event
Temperature Blank	NA	One per cooler
Trip blanks (VOCs only)	NA	One per cooler

**Risk Receptors:**

Pettibone Creek: fish and invertebrates in water; crustaceans, amphibians, small mammals and birds in water and soil/sediment.

Boat Basin: Same as in creek plus small mammals and birds.

**DQO STEP 4: ESTABLISH THE STUDY BOUNDARIES (SEE QAPP FOR FIGURES)**

**Assumptions:**

- Site 17 can logically be subdivided into "the creek" and "the boat basin" because water flow and physical characteristics for these two areas are very different. Even the activities of human receptors with these two areas is very different.
- Residential lot size is a concept that doesn't apply to this problem. Instead, the potential for human receptor interaction with the creek and the boat basin were considered.

- Differentiation between soils and sediments can not necessarily be done in advance of sampling. Therefore, the FOL will have authority to reassign soil and sediment designations to samples at the time of collection.
- The Pettibone Creek rarely floods its main banks and contamination that might have found its way high up on the creek banks routinely gets washed down by precipitation.
- At completion of boat basin dredging (if performed), depth from water surface to sediment will be no more than 10 feet.
- Sampling will not occur at a depth below a natural or concrete bottom of the boat basin.
- Sediment piles in Pettibone Creek provide an opportunity for sediment sample collection because they are contaminant integrators. They could be stratified in contaminant concentrations.
- Earth on creek banks will be considered soil; sediment is the material in the creek bed, preferably under water.
- Stratification of sediment in the boat basin exists in all directions because of different sedimentation rates of large and small particles along the flow direction. However, horizontal homogeneity should be greater than vertical homogeneity.
- The bottom construction material (e.g., concrete or earth) at the bottom of the boat basin is unknown but appears to be earth.

Background sediment and groundwater values may be obtained from locations in the Navy residential area south of the Pettibone Creek because the geology/hydrogeologies of this residential area and Site 17 are similar and because the residential area should be unaffected by Site 17 operations or other Navy operations. The Illinois Stream Sediment report may also be used.

#### *Study Area Boundaries:*

The Pettibone Creek study area ranges from the culvert at the northern end of Pettibone Creek north branch and the golf course/NTC property limit of the south branch downstream to the west end of the bridge upstream of the boat basin. We will only go 1 foot above the high water mark in the creek because

exposure higher than that is unlikely and contamination is also unlikely beyond that point. For human health risk assessment we only need 4 cm of depth. For extent we probably need more.

The boat basin extends from the west end of the bridge upstream of the boat basin to the beginning of the inner harbor. The sediment to a depth of 10 feet will likely be sampled to understand the extent of contamination. For human health risk, only the top sediment layer needs to be sampled. For ecological risk the top inch is most important. Water will also be sampled.

Current thinking is that 10 feet is a reasonable maximum sampling depth because dredging will be to a depth of 10 feet below water level, if dredging is necessary.

The resolution to which the vertical extent of contamination must be evaluated is undecided in the boat basin. One possibility is to sample a representative number of sediment piles in the creek at various depths to determine whether they are stratified. The feasibility of this will depend, at least in part, on the depths of the piles.

The entire subsurface interval will be represented with samples composited over the following intervals (0 to 3 feet, 3 to 6 feet and 6 to 10 feet), except for VOC analyses.

#### ***Temporal considerations***

##### *Assumptions:*

Conditions today will reflect future conditions. Therefore, no modeling will be required.

##### Media:

- Surface water in the boat basin: All depths. Will also sample creek water.
- Sediment in the boat basin: To 10' feet depth below water surface.
- Might have to treat top 4 cm separately for risk assessments.
- VOCs must be collected from areas of soil cores that yield the greatest PID or FID readings.
- Duplicate VOC samples must be collected as close together in a core as feasible.

##### *Physical Sampling Constraint:*

If we sieve the site sediments, we will have to collect much more sample to obtain a useful sample aliquot than if we do not sieve the samples. Because there might not be enough sediment in a given location to support sieving this would be an argument against sieving the samples.

#### **DQO STEP 5: STATE THE DECISION RULES:**

The decision rules are provided as a figure and are presented in the QAPP.

#### **DQO STEP 6: ESTABLISH DECISION PERFORMANCE SPECIFICATIONS**

Error tolerances were developed. The general error tolerance strategy is presented below.

The group discussed the types of errors that could be made:

- A. Unknowingly consider an unacceptably contaminated site to pose no unacceptable risk.
- B. Unknowingly take a corrective action at a site that poses no unacceptable risk.

The consequences of error A were identified as:

- Potential adverse effect to a receptor
- Potentially costly liability
- Potential loss of credibility for the Navy to outside parties
- Potential political concerns generated from making this error

The consequences of error B are generally considered to be less egregious:

- Navy project mgr loss of credibility internally to the Navy
- Spending money to take corrective action when corrective is really not warranted

Error A is generally considered to be the most egregious error.

The null hypothesis would then be established as:

H<sub>0</sub> = The site poses an unacceptable risk

From this the alternative hypothesis would then be established:

H<sub>A</sub> = The site does not pose an unacceptable risk

The team agreed that the alpha and beta levels would be as follows:

- Alpha: 5% at the action level (1E-4 cumulative human health risk)
- Beta: 25% at 1/2 of the action level (1E-4 cumulative human health risk)

Alpha is the tolerance for thinking the cumulative human health risk computed for an exposure unit is less than action level even though the risk exceeds the action level in the exposure unit.

Beta is the tolerance for thinking the cumulative human health risk computed for an exposure unit is greater than the action level even though the risk is less than the action level in the exposure unit.

From this the number of samples will be computed to obtain the desired decision performance.

#### **DQO STEP 7: OPTIMIZE THE DESIGN**

The strengths and weaknesses of the following sampling strategies will be discussed:

- Biased sampling
- Simple random sampling
- Stratified random sampling
- Grid sampling

From the specification above, the SAP will be reviewed and adjusted, as necessary, to optimize sampling and analysis costs against decision performance specifications. The group discussed splitting Pettibone Creek and the boat basin into sections and evaluating historical data variance for each section, then computing the no. of samples required for each section to support decision making.

The project goals will be reviewed:

- Evaluate risks
- Evaluate nature and extent of contamination

Sampling constraints will be discussed

- For example, we might need a skid rig or big tired rig to get onto the sediment, and a boat to get samples in the water

A sampling plan was developed to meet the specifications derived in the first 6 steps of the DQO process.

By considering project objectives and site-specific factors such as spatial coverage and forensic engineering needs, forty-four sediment sampling locations were originally identified for Pettibone Creek and its tributaries. Twelve sediment sampling locations were identified for the Boat Basin with four samples collected at each location for a total of 48 samples. These numbers, 44 and 48, were then evaluated for their expected ability to support decision making with regard to risk evaluation. These

evaluations were performed by using EPA Decision Error Feasibility Trial Software (DEFT beta version 1.0).

The DEFT software takes as inputs the following data:

- expected variability of data for each analyte (in this case, based as much as possible on past site data),
- the tolerance for making Type I and Type II decision errors (generated during DQO meetings), and
- the concentration difference between the Action Level and the decision making Gray Region boundary (Also generated during DQO meetings. See the DEFT User's Manual for details).

The Boat Basin was treated separately from Pettibone Creek because of its unique features. Pettibone Creek and tributaries within the Site 17 limits were treated two different ways in an attempt to maximize potential stratification of contaminants within the creek branches. First the entire creek within Site 17 limits was treated as a single unit. Then it was treated as two subsets – the North Pettibone Creek branch and the South Pettibone Creek branch. Thus, four different situations were considered. The number of samples was computed for each target analyte for each of the four scenarios.

In most of the scenarios for the analytes, the computed number of samples was significantly less than 44 samples, and was almost always less than 10 samples. This indicates that the 44 and 48 sediment samples planned for collection in Pettibone Creek and the Boat Basin, respectively, are more than sufficient to evaluate risk for most analytes. However, there were some analytes for which the required numbers of samples were in the hundreds to thousands. This is partially attributed to an artifact of the DEFT software, as explained below.

The DEFT software is set up to compute the number of samples required to discriminate between a Gray Region boundary and an action level. Let this be known as the Gray Region Delta (GRD). In principle, the narrower this difference, the greater the number of samples will be required to discriminate between the two limits. The DEFT software is a variation on a standard statistical power calculation that is designed to discriminate between the mean concentration of a parameter (not the Gray Region boundary) and a constant value (the equivalent of an action level). Let this standard difference be known as the Standard Power Delta (SPD). Again the smaller the SPD, the greater the number of samples required to detect a difference equal to the SPD.

Occasionally, the Gray Region boundary is close to the Action Level even when the true analyte concentration is far from the action level. That is, the GRD is much smaller than the SPD. In that case, the number of samples needed to establish the GRD would be greater than what is needed to establish



the SPD, because the GRD is smaller than the SPD. Sometimes, the discrepancy is huge. Because the SPD is more representative of site conditions (i.e., what will be found when sampling is actually implemented), the DEFT software was abandoned in favor of the standard statistical power calculation when this situation occurred

For Pettibone Creek sediments, 29 of approximately 200 *N* values were recomputed using the standard statistical power calculation. Five of the recomputed *N* values increased but, of those five, one was still less than 25. Several of the other recomputed *N* values decreased dramatically to values much less than 25. Eleven of the final *N* values remain greater than or equal to 26 and range as high as 353.

For Boat Basin sediments, nine of approximately 70 *N* values were recomputed. Two of the recomputed values increased but are less than 12. The *N* values for Boat Basin sediments are now less than 48.

In summary, if the calculation inputs are accurate, the recomputed *N* values indicate that the current sampling plan could yield an insufficient number of samples for evaluating risk due to 4 analytes (copper, lead, bis(2-ethylhexyl)phthalate and indeno(1,2,3-CD)pyrene) at Pettibone Creek. However, the recalculated *N* values suggest that between 80 and 353 samples could be required to provide the desired level of confidence in the decisions for Pettibone Creek. Given the stage of this investigation and the limited negative impact that these calculations are indicating for the project, the project planning team decided to proceed with 44 sediment samples across Pettibone Creek and its tributaries and 48 samples in the Boat Basin. If the *N* value calculations are verified to be correct, additional data may have to be collected for Pettibone Creek, or some compromises may have to be made when making decisions for the four analytes identified here.

## **APPENDIX IV**

### **LABORATORY STANDARD OPERATING PROCEDURES**

<u>SOP Number</u>	<u>Title</u>
LQM	Section 8.0 – Work Processes and Operations, Excerpted from Lab Quality Manual
LQM	Section 9.0 – Quality Assessment and Response, Excerpted from Lab Quality Manual
QAMP	Quality Assurance Management Plan
QA-001	Standard Operating Procedures
QA-003	Quality Control Program
QA-005	Determination of Method Detection Limits for Chemical Tests
QA-008	Data Recording Requirements
QA-009	Reporting Limits
QA-011	Acceptable Manual Integration Practices
QA-014	Determination of IDL
PITT-QA-0003	Glassware Prep
NC-QA-0018	Statistical Evaluation of Data and Development of Control Charts
PITT-QA-0051	Sample Receiving and Chain of Custody
CORP-MT-0006	Preparation and analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption Spectroscopy, Method 245.5 CLP-M, SOW ILMO3.0
CORP-MT-0008	Preparation and analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption Spectroscopy, Method 245.5 CLP-M, SOW ILMO3.0
CORP-MS-0002-PT	Determination of Volatile Organics by GC/MS Methods 8260B, 624 and 524.2
CORP-MS-0001-PT	GC/MS based on Methods 8270C and 625
CORP-GC-0001PT	Gas Chromatography Analysis based on Method 8000B, 8021A, 8081A, 8082, and 8151A; SW-846 8141A and 8310
CORP-MT-0001	Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analyses, SW846 Method 6010B and EPA Method 200.7
CORP-MT-0005PT	Preparation and Analysis of Mercury in Aqueous Samples by Cold Vapor Atomic Absorption Spectroscopy, SW 846 7470A and MCAWW 245.1

CORP-MT-0007	Preparation and Analysis of Mercury in Solid Samples by Cold Vapor Atomic Absorption Spectroscopy, SW 846 7471A and MCAWW 245.5
PITT-WC-0018	Cyanide-Semi-Automated, Pyridine-Barbituric Acid for Total (Method 335.4) and Amenable (SM 4500-6) Cyanide Analyses in Water and Soil (Method 9012A)
CORP-IP-0004	Toxicity Characteristic Leaching Procedure and Synthetic Precipitation Leaching Procedure
NC-WC-0017	Total Organic Carbon (TOC) and Total Inorganic Carbon (TIC) SW 846 Method 9060 and EPA Method 415.1
PITT-WC-0058	Total Organic Carbon Analyses for Solid Matrices by Walkley Black
AVS/SEM	Acid Volatile Sulfide (AVS) and Selected Simultaneous Extractable Metals in Sediment
S3A	Test Method for Particle Size of Soils – Geotechnics
PITT-WC-0026	PH electrometric EPA Method 150.1 Method 9045C (soil) and SW846 9040B
Navy IR CDQM	Navy Installation Restoration Chemical Data Quality Manual (IR CDQM)
DOD QSM	Department of Defense Quality Systems Manual for Environmental Laboratories

**LABORATORY STANDARD OPERATING PROCEDURES - SEE VOLUME II**

## **APPENDIX V**

### **SUPPLEMENTAL FIELD SAMPLING PLAN AND FIELD STANDARD OPERATING PROCEDURES**

**Supplemental Field Sampling Plan  
for  
Remedial Investigation/Risk Assessment  
at  
SITE 7 RTC Silk Screening Shop  
and  
SITE 17 Pettibone Creek/Boat Basin**

**Naval Training Center  
Great Lakes**  
Great Lakes, Illinois



**Southern Division  
Naval Facilities Engineering Command**

**Contract Number N62467-94-D-0888**

**Contract Task Order 0154**

July 2001

## TABLE OF CONTENTS

<b><u>SECTION</u></b>	<b><u>PAGE NO.</u></b>
<b>ACRONYMS/ABBREVIATIONS.....</b>	<b>V-2</b>
<b>1.0 INTRODUCTION.....</b>	<b>V-4</b>
1.1 INTRODUCTION.....	V-4
1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES.....	V-5
1.2.1 Project Organization.....	V-5
1.3 PROJECT QUALITY ASSURANCE.....	V-5
<b>2.0 FIELD OPERATIONS.....</b>	<b>V-6</b>
2.1 GENERAL FIELD OPERATIONS.....	V-6
2.1.1 Mobilization/Demobilization.....	V-6
2.1.2 Site Restoration.....	V-6
2.2 SUBSURFACE INVESTIGATIONS.....	V-7
2.2.1 Soil Boring Installation.....	V-7
2.2.2 Borehole and Sample Logging.....	V-7
2.2.3 Borehole Abandonment.....	V-8
2.3 TEMPORARY MONITORING WELL CONSTRUCTION AND INSTALLATION.....	V-8
2.3.1 Temporary Monitoring Well Construction.....	V-8
2.3.2 Temporary Monitoring Well Development.....	V-9
2.3.3 Temporary Monitoring Well Protection.....	V-9
2.3.4 Temporary Monitoring Well Abandonment.....	V-9
2.4 GENERAL SAMPLING OPERATIONS.....	V-9
2.4.1 Groundwater Sampling.....	V-9
2.4.2 Soil Sampling.....	V-11
2.4.3 Surface Water Sampling.....	V-12
2.4.4 Sediment Sampling.....	V-12
2.5 AQUIFER TESTING.....	V-13
2.5.1 Slug Tests.....	V-13
2.6 FIELD SAMPLE DOCUMENTATION.....	V-13
2.7 SAMPLE HANDLING, PACKAGING, AND SHIPPING.....	V-13
2.8 QUALITY CONTROL (QC) SAMPLES.....	V-13
2.9 FIELD MEASUREMENTS.....	V-14
2.9.1 Equipment Calibration.....	V-14
2.9.2 Field Instrument Preventive Maintenance Procedure/Schedule.....	V-14
2.10 FIELD CORRECTIVE ACTION.....	V-14
2.11 SURVEYING.....	V-17
2.12 DECONTAMINATION.....	V-17
2.12.1 Major Equipment.....	V-17
2.12.2 Sampling Equipment.....	V-17
2.13 INVESTIGATION DERIVED WASTE HANDLING.....	V-18
2.14 SITE MANAGEMENT AND FACILITY SUPPORT.....	V-18
2.15 RECORD KEEPING.....	V-18



**SECTION**

**PAGE NO.**

<b>3.0</b>	<b>SITE-SPECIFIC FIELD SAMPLING PLANS.....</b>	<b>V-20</b>
3.1	SITE 7 – RTC SILK SCREENING SHOP.....	V-20
3.2	SITE 17 – PETTIBONE CREEK & THE BOAT BASIN .....	V-20

<b>REFERENCES .....</b>	<b>V-22</b>
-------------------------	-------------

**APPENDICES**

<b>A</b>	<b>FIELD FORMS</b>
<b>B</b>	<b>STANDARD OPERATING PROCEDURES</b>
<b>C</b>	<b>FIELD AUDIT CHECKLIST</b>

## ACRONYMS/ABBREVIATIONS

ASTM	American Society of Testing Materials
bgs	Below Ground Surface
CLEAN	Comprehensive Long-Term Environmental Action, Navy
COC	Chain of Custody
CTO	Contract Task Order
DI	Deionized
DO	Dissolved Oxygen
DOT	Department of Transportation
DPT	Direct-Push Technology
°C	Degrees Celsius
FOL	Field Operations Leader
FSP	Field Sampling Plan
FTMR	Field Task Modification Request
HASP	Health and Safety Plan
HSA	Hollow Stem Auger
ID	Inside Diameter
IDW	Investigation Derived Waste
IEPA	Illinois Environmental Protection Agency
mS/cm	MilliSiemens per Centimeter
NSF	National Sanitation Foundation
NTC	Naval Training Center
NTU	Nephelometric Turbidity Units
ORP	Oxidation-Reduction Potential
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
RPM	Remedial Project Manager

SOP	Standard Operating Procedure
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TOM	Task Order Manager
TSS	Total Suspended Solids
TiNUS	Tetra Tech NUS, Inc.
U.S. EPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
WP	Work Plan

## **1.0 INTRODUCTION**

### **1.1 INTRODUCTION**

This Field Sampling Plan (FSP) supplements the Quality Assurance Project Plan (QAPP) and describes the sampling and analysis procedures to be used for the remedial investigation and risk assessment activities. Tetra Tech NUS, Inc. (TtNUS) will conduct these activities under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Contract Number N62467-94-D-0888, Contract Task Order (CTO) 154 at the Naval Training Center (NTC) Great Lakes, Illinois. These activities will be conducted in accordance with the statement of work for CTO 154 and the Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. EPA, 1988)

This FSP specifies requirements for field work that may be undertaken at the NTC Great Lakes facility under this CTO and serves as a guide for use in the field by the field investigation team members. This investigation will comply with applicable Illinois Environmental Protection Agency (IEPA), Southern Division Naval Facilities Engineering Command (SOUTHDIV), and United States Environmental Protective Agency (U.S. EPA) regulations and guidance.

The field investigation at NTC Great Lakes will consist of the following tasks:

- Mobilization/demobilization
- Field equipment maintenance
- Drilling
  - Installation of soil borings
  - Installation of temporary monitoring wells
  - Abandonment of wells
- Soil sampling
  - Surface soil sampling
  - Subsurface soil sampling
- Groundwater sampling
  - New temporary monitoring wells
- Surface water/sediment sampling
- Equipment decontamination
- Aquifer Testing

- Groundwater level measurements
- Investigation-derived waste (IDW) handling and disposal
- Site Restoration
- Land Surveying of Sample Locations

This FSP consists of three sections. Section 1.0 presents an introduction to the sampling and analysis plan. Section 2.0 describes the field operations, investigation tasks, environmental sampling and analytical procedures, waste handling, site management and facility support, and recordkeeping. Section 3.0 describes site-specific field sampling plans. Site-specific Field Forms and Standard Operating Procedures (SOPs) for the proposed activities are included in Appendices A and B, respectively, of this Supplemental FSP. Section B of the QAPP details site-specific field sampling plans.

## **1.2 PROJECT ORGANIZATION AND RESPONSIBILITIES**

TtNUS will be responsible for the implementation of the project, including the field inspection and implementation of the sampling activities. Personnel from the Navy will be actively involved in the investigation planning and will coordinate with personnel from TtNUS in a number of areas.

### **1.2.1 Project Organization**

The key organizations and personnel involved in the investigation, as well as the chain of communication and responsibility of the project personnel, are described in Section A of the QAPP.

## **1.3 PROJECT QUALITY ASSURANCE**

Quality assurance for the work on this project may consist of random TtNUS Internal Field Technical System Audits or U.S. EPA, IEPA, or Navy external field audits as described in Section A of the QAPP. The field audit checklist for the TtNUS Internal Field Technical System Audit is included in Appendix C of this Supplemental FSP.

## **2.0 FIELD OPERATIONS**

### **2.1 GENERAL FIELD OPERATIONS**

This section discusses sampling operations, procedures, and proper documentation for the field operations to be performed for the remedial investigation and risk assessment for Site 7 RTC Silk Screening Shop and Site 17 Pettibone Creek/Boat Basin at NTC Great Lakes, Illinois.

#### **2.1.1 Mobilization/Demobilization**

Following approval of the QAPP (including FSP), TtNUS will begin mobilization activities. In addition to this FSP, field team members will review the planning documents, QAPP, and Health and Safety Plan (HASP) prior to the start of project activities. In addition, a field team orientation meeting will be held by the Field Operations Leader (FOL) to make certain that personnel are familiar with the scope of the field activities. The FOL will coordinate the mobilization activities upon arrival at the Facility.

Before the initiation of field work, the FOL will initiate onsite mobilization activities. These activities include coordination with base personnel and the clearing of drilling locations with the appropriate utilities. NTC Great Lakes Environmental Department will provide an area for use as a field office. Equipment required for the field activities may be shipped or driven from the TtNUS Pittsburgh warehouse to the site. After field activities are completed, the FOL will be responsible for the demobilization of the equipment and the field office.

The site preparation will be coordinated through NTC Great Lakes Environmental Department personnel. When necessary, temporary barriers and traffic control will be provided at drilling locations as a safety precaution.

Additional details regarding responsibilities and authorities of key personnel are presented in Section A of the QAPP.

#### **2.1.2 Site Restoration**

The site restoration activities will be performed by TtNUS and its subcontractors. Site restoration may include, but is not limited to, regrading areas where drilling activities were performed, and replacing asphalt or concrete in areas disturbed by sampling activities.

## **2.2 SUBSURFACE INVESTIGATIONS**

### **2.2.1 Soil Boring Installation**

Boreholes for soil sampling and monitoring well installation will be drilled using direct-push and hollow-stem auger methods. The drilling method selected will depend on the type of samples being collected at a location, boring depths, and site characteristics. However, whenever possible, the direct-push drilling method will be used to collect soil samples for analytical and lithologic descriptive purposes. Hollow-stem auger techniques will be used to enlarge these borings to allow for the installation of monitoring wells. The borings for soil sampling will be drilled in accordance with SOP CTO 154-6 and logged in accordance with SOP CTO 154-13, both contained in Appendix B.

#### **2.2.1.1 Direct-Push Drilling**

The direct-push technique (DPT) involves pushing sampling tools hydraulically or mechanically into the ground to the desired depth. A primary advantage of DPT over conventional drilling techniques is that DPT generates little or no drill cuttings. Disadvantages include limited penetration depth of 15 to 40 feet and small sample volume.

#### **2.2.1.2 Hollow-Stem Auger Drilling**

The hollow-stem auger (HSA) drilling technique with DPT macrocore or split-spoon sampling may be used for soil sampling. HSAs are advanced to a depth immediately above the sample depth. A split-spoon sampler is driven through the auger by means of a drill-rig-mounted hammer weighing 140 pounds falling 30 inches for each blow (standard penetration test). The interval at which a split-spoon sample will be collected will be based on the specific purpose or needs of the sampling effort. As mentioned above, it is anticipated that the HSA technique will be used to enlarge DPT borings to allow for the installation of semi-permanent monitoring wells. In this case, split-spoon samples will not be collected.

### **2.2.2 Borehole and Sample Logging**

DPT and/or split-spoon samples obtained from soil borings will be monitored for volatile organics immediately upon opening the sample tool by passing a photoionization detector (PID) along the sample's length. The PID results will be recorded on the boring log. Soil samples collected for chemical analysis should be done so in accordance with the procedures outlined in Section 2.4.2.

A lithologic description of each soil sample and a complete log of each boring should be maintained by the TtNUS geologist in accordance with SOP CTO 154-13, contained in Appendix B. At a minimum, the boring log will contain the following information:

- Well identification (if applicable)
- Boring identification
- Name of geologist logging the boring
- Name of drilling contractor
- Sample numbers and types
- Sample depths
- Standard penetration test data
- Sample recovery/sample interval
- Soil density or cohesiveness
- Soil color
- Unified Soil Classification System (USCS) material description
- Location of boring
- Drilling and well construction problems/deviations from project specific FSP.

In addition, depths of changes in lithology, sample moisture observations, depth to water, presence of organic vapor (i.e., PID readings), drilling methods, and total depth of each borehole are included on each log, as well as other pertinent observations. An example of the boring log form is attached in Appendix I. The driller shall prepare a separate written boring log for each boring drilled. The driller's boring log and/or a daily record of drilling activities are submitted to the field geologist at the conclusion of the daily field activities.

### **2.2.3      Borehole Abandonment**

Refer to Section B2 of the QAPP.

## **2.3            TEMPORARY MONITORING WELL CONSTRUCTION AND INSTALLATION**

Refer to Section B2 of the QAPP.

### **2.3.1      Temporary Monitoring Well Construction**

Refer to section B2 of the QAPP.



### **2.3.2 Temporary Monitoring Well Development**

Refer to section B2 of the QAPP.

### **2.3.3 Temporary Monitoring Well Protection**

Once the monitoring well is completed a temporary flush mount cover (at a minimum 6-inch round security vault provided with sealing gasket to reduce the amount of water infiltration) will be grouted a minimum of three feet into the ground. The flush mounted casings will be completed level with existing grade. A locking "J-plug type" cap will be placed and secured on top of each well casing to protect it from tampering/opening.

To maintain well security, the wells will be locked using locks that are keyed alike.

### **2.3.4 Temporary Monitoring Well Abandonment**

Refer to Section B2 of the QAPP.

## **2.4 GENERAL SAMPLING OPERATIONS**

This section discusses the sampling methodology for groundwater, surface soil, subsurface soil, surface water, and sediment sampling activities to be performed at NTC Great Lakes, Illinois. Sample locations and analytical requirements, including field test methods, for these samples will be detailed in Section 3.0 on a site-specific basis. Summaries of sample containers, sample volume, preservation requirements, and analytical methodology are provided in Tables B-10 and B-11.

### **2.4.1 Groundwater Sampling**

Ground water samples will be collected from the seven temporary monitoring wells at NTC Great Lakes and submitted for fixed-based laboratory analyses. The specific wells that will be sampled are described in the QAPP. The objective of this section is to provide guidance for the proper use of sampling equipment and proper techniques for groundwater sample collection. Groundwater sampling will be conducted in accordance with the requirements of the project QAPP and in accordance with SOP CTO 154-3, contained in Appendix B.

#### **2.4.1.1 Water Level Measurements**

Refer to Section B2 of the QAPP.

#### **2.4.1.2 Well Purging**

Purging and sampling will be accomplished using low-flow techniques in accordance with SOP CTO 154-2. The low-flow procedures are based on the 1996 paper entitled "Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, EPA/540/S-95/504 (Puls, R.W., and M.J. Barcelona, 1996). Low-flow purging and sampling will be implemented because this method provides the least disturbance to the surrounding formation (i.e., less turbulence in sampling and hence less turbidity) and allows for a more representative sample to be collected. Field measurements of pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), turbidity, and water levels are taken during the purging process.

Wells will be purged prior to sampling using a peristaltic pump or bladder pump, depending on well depth. Surface-type pumps (peristaltic pumps) will use disposable tubing that will be washed and disposed as trash (see Section 2.13). Submersible pumps (bladder pumps) will require decontamination between each well point.

Upon opening the well cap, a PID reading of air within the riser pipe will be taken prior to purging or sampling to determine appropriate personal protective equipment. After recording the PID reading, the water level and the total depth of the monitoring well will be measured to within 0.01 foot accuracy from the marked location on the top of the well riser pipe using an M-scope. Water levels will be monitored every 5 to 10 minutes as purging occurs.

Initially, the pumping rate will be set at approximately 0.1 liters per minute, or lower if possible. The pumping rate will be reduced if turbidity is greater than 10 NTUs after the field parameters have stabilized.

The pumping rates will be adjusted to prevent drawdown from exceeding 0.3 feet during purging. If ground water is drawn down below the pump intake, purging will cease, and the well will be allowed to recover before purging continues. Slow recovering wells will be identified and purged at the beginning of the workday. If possible, samples will be collected from these wells within the same 8-hour workday. During purging, water quality parameters (pH, turbidity, specific conductance, temperature, ORP, and

DO) will be measured and recorded every 5 to 10 minutes using a multi-parameter analyzer. Stabilization of the above parameters is defined as follows:

- Temperature  $\pm 3\%$
- pH  $\pm 0.1$  standard units
- turbidity  $< 10$  NTUs, and
- specific conductance  $\pm 3\%$ , and
- DO  $\pm 10\%$

Well purging will continue until the parameters have stabilized and the minimum purge volume (stabilized well volume plus the extraction tubing volume) has been removed. If the parameters have not stabilized within 4 hours or after three well volumes have been purged, this information will be recorded and sampling will begin.

Purge water will be containerized into appropriate containers and staged at an NTC-approved location.

#### **2.4.1.3 Sampling of Monitoring Wells**

Monitoring wells will be sampled using low-flow purging and sampling techniques. Sample handling and custody procedures are discussed in Sections 2.6 and 2.7, respectively.

Monitoring wells will be sampled using the same pump (peristaltic or bladder) and tubing used during well purging. Immediately following the purging process and before sampling, the temperature, pH, specific conductance, DO, ORP, and turbidity of the water sample will be measured and recorded on the Groundwater Sample Log Sheet (included in Appendix A).

Sample containers will be filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Samples for volatile analysis will be collected first by the pipette method (see Appendix B) and immediately sealed in a container so that no head space exists. Samples for semivolatile compounds, pesticides/polychlorated biphenyls (PCBs), and metals analyses will be collected next. Immediately after collection, samples will be sealed and placed in a cooler at 4°C.

#### **2.4.2 Soil Sampling**

Within most soil borings, two soil intervals will be collected for quantitative laboratory analysis. The surface interval will be collected. The subsurface interval for volatile organics will be selected in the field

based on the presence of certain screening criteria or, in the absence of criteria, randomly. A soil composite will be collected for semivolatile and inorganic analysis.

#### **2.4.2.1 Surface Soil Sampling**

Refer to section B2 of the QAPP.

#### **2.4.2.2 Sample Field Screening**

A screening process will be used to select a subsurface soil interval from which to sample volatiles. Selection will be based on PID qualitative volatile organic measurements, visual observation of staining, or wet soils [defining the uppermost (surficial) ground water aquifer]. The primary goal of the screening process is to select the most contaminated subsurface soil interval by PID or staining. Failing this, the secondary goal is to select the most relevant soil interval by identifying the soil interval immediately above (and most likely to impact) the uppermost ground water. In the absence of volatiles, staining, or free water, a random interval will be collected to represent the exposure of receptors from subsurface soils. To minimize unused volatile samples, a random interval will be identified before pushing or drilling the soil boring. If volatiles are not elevated, staining is not observed, and ground water is not identified above the pre-defined random interval, then the VOC samples will be collected from this random interval.

#### **2.4.2.3 Subsurface Soil Sampling**

Refer to Section B2 of the QAPP.

#### **2.4.3 Surface Water Sampling**

Surface water samples will be collected from the locations described in Section B2 of the QAPP and submitted to a fixed-based laboratory. The objective of this section is to present the proper use of sampling equipment and proper techniques for sample collection. Surface water sampling will meet the requirements of the project QAPP and SOP CTO 154-4, contained in Appendix B.

#### **2.4.4 Sediment Sampling**

Sediment samples will be collected from the locations described Section B2 of the QAPP and submitted to a fixed-based laboratory. The objective of this section is to present the proper use of sampling equipment and proper techniques for sample collection. The sediment sampling will meet the requirements of the QAPP and SOP CTO 154-5, contained in Appendix B.

## **2.5      AQUIFER TESTING**

Aquifer testing will be conducted at a minimum of three of the newly installed wells at NTC Great Lakes.

### **2.5.1      Slug Tests**

Refer to Section B2 of the QAPP.

## **2.6      FIELD SAMPLE DOCUMENTATION**

Sample documentation consists of the completion of the Chain of Custody (COC) forms and matrix-specific sample logsheets. COC forms are discussed in Section B of the QAPP. Additionally, COC forms are explained in the SOP CTO 154-10. The sample logsheets contain information such as container source and description; sample type; and time, date, and method of sample collection. Problems or unusual circumstances encountered during sample collection are noted on the form. Sample logsheets are sequentially numbered and placed in a sample logbook. Examples of sample logsheets for the various media are contained in Appendix A.

The samples obtained at NTC Great Lakes will be properly labeled with a sample label affixed on the sample container. Detailed information to be written on the sample labels is outlined in SOP CTO 154-9 (Appendix B).

## **2.7      SAMPLE HANDLING, PACKAGING, AND SHIPPING**

Refer to Section B3 of the QAPP.

## **2.8      QUALITY CONTROL (QC) SAMPLES**

In addition to calibration of field equipment and appropriate documentation, QC samples are collected or generated during environmental sampling activities. QC samples include field duplicates, ambient condition blanks, source water blanks, equipment rinsate blanks, and trip blanks. Each type of field quality control sample, as well as additional sample aliquots needed to accommodate laboratory QC analyses, are explained in detail in Section B5 of the QAPP.

## **2.9 FIELD MEASUREMENTS**

Field measurements will be recorded during field sampling operations. These measurements include ambient air quality, water temperature, pH, turbidity, specific conductance, ORP, DO, and water-level measurements. Ambient air quality measurements include monitoring of organic vapors in the breathing zone during intrusive field investigation activities and monitoring of organic vapors emanating from site sources such as soil samples and well casings. Several instruments used during field activities to achieve these measurements include the following:

- PID
- YSI Model 6 series, Multi-Parameter Water Quality Meter (or equivalent)
- M-scope

The YSI Model 6 (or equivalent) is to be used for both ground and surface water measurements. SOP CTO 154-2 in Appendix B provides additional details concerning the PID.

### **2.9.1 Equipment Calibration**

As a rule, instruments used in the field will be calibrated daily prior to use and calibration fluids will be measured at the end of each day. These instruments will be calibrated according to manufacturer requirements.

Calibration of the water quality meter is described in SOP CTO 154-14 located in Appendix B.

For specific instructions on calibration procedures, calibration frequency, the acceptance criteria and the conditions that will require more frequent calibration regarding the PID, see SOP CTO 154-12 (Appendix B).

### **2.9.2 Field Instrument Preventive Maintenance Procedure/Schedule**

See Section B2 of the QAPP.

## **2.10 FIELD CORRECTIVE ACTION**

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or "out of quality control" performance that can affect data quality.

Corrective action in the field could result when the sample network is changed (e.g., more/less samples, sampling locations other than those specified, etc.), and sampling procedures and/or field analytical procedures require modification. Project personnel will be responsible for reporting suspected technical or QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the FOL or designee. The TOM will be responsible for assessing the suspected problems in consultation with the Quality Assurance Manager and making a decision based on the potential for the situation to affect the quality of the data. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, then a nonconformance report will be initiated by the FOL.

The FOL will be responsible for making sure that corrective action for nonconformances is initiated by:

- Evaluating reported nonconformances
- Controlling additional work on nonconforming items
- Determining disposition or action to be taken
- Maintaining a log of nonconformances
- Reviewing nonconformance reports and corrective action taken
- Including nonconformance reports in the final site documentation and project files.

If appropriate, the FOL will make sure that no additional work that is dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include the following:

- Repeat the measurement to check the error
- Check for proper adjustments for ambient conditions such as temperature
- Check the batteries
- Re-calibration
- Check the calibration
- Replace the instrument or measurement devices
- Stop work (if necessary).

The FOL or his or her designee is responsible for the site activities. In this role, the FOL at times is required to adjust the site programs to accommodate site-specific needs. When it becomes necessary to modify a program, the following field change procedure must take place:

- The responsible person notifies the FOL of the anticipated change.
- The FOL notifies the TOM of the need for the change.
- If necessary, the TOM discusses the change with the pertinent individuals [e.g., the Navy Remedial Project Manager (RPM), TtNUS Quality Assurance Manager]. Verbal or written approval or denial of the proposed change is then given to the FOL.
- If acceptable, the FOL then documents the change on a Field Task Modification Record (FTMR) form. The FTMR form documents the need for the change from original procedures outlined in the FSP, when the change was made and how the change was made.
- The FOL forwards the Field Task Modification Requests (FTMR) to the TOM at the earliest convenient time (e.g., end of the workweek).
- The TOM signs the form and distributes copies to the Navy RPM, FOL, and project file. The RPM will be notified whenever program changes are made in the field.
- A copy of the completed FTMR is attached to the field copy of the affected document.

Corrective action resulting from internal field audits will be implemented immediately if data may be adversely affected because of unapproved methods or improper use of approved methods. The TtNUS Quality Assurance Manager will identify deficiencies and recommend corrective action to the TOM. Implementation of corrective actions will be performed by the TtNUS field investigation team as directed by the FOL. Corrective action will be documented in quality assurance reports distributed to the entire project management team.

Corrective actions will be implemented and documented in the field logbook. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the Navy RPM.

Calibration is documented on an Equipment Calibration Log (see Appendix A). During calibration, an appropriate maintenance check is performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact



on the instrument's performance, the instrument is removed from service until the defective parts are repaired or replaced.

## **2.11 SURVEYING**

Refer to Section B2 of the QAPP.

## **2.12 DECONTAMINATION**

The equipment involved in field sampling activities will be decontaminated before beginning work, during drilling and sampling activities, and at the completion of the project. This equipment includes drilling rigs, down-hole tools, augers, well casing and screens, and soil and water sampling equipment.

### **2.12.1 Major Equipment**

Downhole equipment, including downhole drilling tools, are cleaned with high-pressure hot water, between boreholes, whenever the drilling rig leaves the drill site prior to completing a boring, and at the conclusion of the drilling program.

Well casing and screens, if not supplied at the site in certified clean (NSF) packaging, will be cleaned with high-pressure hot water before installation into the borings.

Decontamination activities take place at a predetermined area within NTC Great Lakes. Additional requirements for drilling equipment decontamination are found in SOP CTO 154-8 provided in Appendix B.

### **2.12.2 Sampling Equipment**

Nondedicated reusable sampling equipment used for collecting samples will be decontaminated both before field sampling and between samples. This equipment includes hand augers, trowels, split-spoon samplers, mixing bowls, clamshell dredges, and hollow sample tubes. The following decontamination steps will be conducted:

- Potable water, phosphate-free detergent wash (scrub if necessary)
- Potable water rinse
- Deionized (DI) water rinse
- Isopropanol (only if oily soil conditions are encountered).

- Deionized water rinse
- Air dry (if possible)
- Wrap in aluminum foil (if not to be used immediately)

Additional guidance for decontamination is supplied in SOP CTO 154-8 contained in Appendix B.

Disposable equipment used for sampling activities shall be decontaminated using detergent wash and potable water rinse, placed in plastic garbage bags, and discarded in dumpsters at NTC Great Lakes.

Field analytical equipment such as pH, conductivity, and temperature probes will be rinsed first with analyte-free water, then with the sample liquid. Water level measurement devices will be rinsed with potable water.

## **2.13 INVESTIGATION DERIVED WASTE HANDLING**

Refer to Section B2 and A.12 of the QAPP.

## **2.14 SITE MANAGEMENT AND FACILITY SUPPORT**

The FOL will be designated as the lead in coordinating the day-to-day activities during the investigation. The FOL is responsible for making sure that the field team members (including subcontractors) are familiar with the FSP, QAPP, and site-specific HASP. Additionally, the FOL will be responsible for the sampling operations, Quality Assurance/Quality Control, field documentation requirements, and field change orders. The FOL will also regularly report to the TOM regarding the status of field work and problems that may occur.

Site preparation, mobilization/demobilization, and sampling activities will be coordinated through NTC Great Lakes Environmental Department personnel.

## **2.15 RECORD KEEPING**

Various hard cover, bound, record books will be maintained for each field activity in accordance with SOP CTO 154-10, contained in Appendix B. The Master Site Logbook serves as the overall record of field activities. Information included daily in the Master Site Logbook includes daily field activities, weather conditions, identity and arrival and departure times of personnel, management issues, etc. Various field notebooks will also be maintained. For example, the geologist supervising drilling operations may maintain a field notebook.

The FOL is responsible for the maintenance and security of the field records. Eventually, the field records (COCs, sample logsheets, logbooks, and notebooks) will be docketed and incorporated in the central project file.

The FOL is responsible for initiation and completion of FTMRs. These FTMRs are specific forms initiated when a change to or deviation from procedures provided for in the project planning documents occurs. The procedure for requesting and recording field changes is outlined in Section 2.10.

### **3.0 SITE-SPECIFIC FIELD SAMPLING PLANS**

#### **3.1 SITE 7 – RTC SILK SCREENING SHOP**

Background information about the Site 7 RTC Silk Screening Shop, including a site description and summary of previous investigations, can be found in Section A5 of the QAPP. A detailed description of the proposed investigation for Site 7 is included in Section B2 of the QAPP. The objectives of the proposed investigation are as follows:

- To determine human health and ecological risks for potential receptors exposed to site media under current and future land use scenarios.
- To determine if groundwater has been adversely affected by the site activities.

Proposed sampling activities at the Site 7 RTC Silk Screening Shop to meet these objectives is summarized in Section B2 of the QAPP. Figure B-1 in the QAPP shows proposed sampling locations and Tables B-1 through B-5 in the QAPP is a summary of the samples that will be collected at Site 7. Sample containers, preservation requirements, and holding times are provided in Tables B-10 and B-11.

#### **3.2 SITE 17 – PETTIBONE CREEK & THE BOAT BASIN**

Background information about Pettibone Creek and the Boat Basin, including a site description and summary of previous investigations; can be found in Section A5 of the QAPP. A detailed description of the proposed investigations for Pettibone Creek and the Boat Basin is included in Section B2 of the QAPP. The objectives of the proposed investigations are as follow:

- To determine human health and ecological risks for potential receptors exposed to the site media under current and future land use scenarios.
- To determine if surface water and sediment have been adversely affected.

Proposed sampling activities at Pettibone Creek and the Boat Basin to meet these objectives is presented in Section B2 of the QAPP. Figures B-2 and B-3 in the QAPP show the proposed sediment and surface water sampling locations, respectively, and Tables B-6 through B-9 in the QAPP is a summary of the samples that will be collected at Site 17. Inert pebbles and organic detritus will be removed from the

sample by hand before the sample bottle is sealed and shipped to the laboratory. Sample containers, preservation requirements, and holding times are provided in Tables B-10 and B-11.

## REFERENCES

Puls, R.W. and M.J. Barcelona, 1996. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures. EPA/540/S-95/504.

SOUTHDIV (Southern Division Naval Facilities Engineering Command), 1997. Monitoring Well Design, Installation, Construction, and Development Guidelines. Interim Final, Revision 0. March 27, 1997.

U.S. EPA, 1983. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020. Environmental Monitoring and Support Laboratory, Office of Research and Development. Cincinnati, OH.

U.S. EPA, 1986. Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods, SW-846, 3rd Edition including Updates. Office of Solid Waste and Emergency Response, Washington, D.C.

## **APPENDIX A**

### **FIELD FORMS**



## CHAIN OF CUSTODY

**3ER**

PAGE \_\_\_\_ OF \_\_\_\_

**DISTRIBUTION:** WHITE (ACCOMPANIES SAMPLE)

YELLOW (FIELD COPY)

PINK (FILE COPY)

3/99  
FORM NO. TINUS-001





# EQUIPMENT CALIBRATION LOG

PROJECT NAME : NTC GREAT LAKES

INSTRUMENT NAME/MODEL:

SITE NAME: GREAT LAKES

MANUFACTURER:

PROJECT No.: 3939 CTO 154

SERIAL NUMBER: \_\_\_\_\_

[illegible]



## DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : NTC GREAT LAKES

INSTRUMENT NAME/MODEL: \_\_\_\_\_

SITE NAME:

MANUFACTURER: \_\_\_\_\_

PROJECT No.: 3939 CTO 154

SERIAL NUMBER: \_\_\_\_\_

[illegible]

## BORING LOG

PROJECT NAME: NTC GREAT LAKES

**BORING NUMBER:**

PROJECT NUMBER: N3939 CTO 0154

DATE:

**DRILLING COMPANY:**

**GEOLOGIST:**

**DRILLING RIG:**

**DRILLER:**

[illegible]

\* When rock coring, enter rock brokenness.

\*\* Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks:

### Drilling Area

Background (ppm):

### Converted to Well:

**Yes**

No

Well I.D. #:



Tetra Tech NUS, Inc.

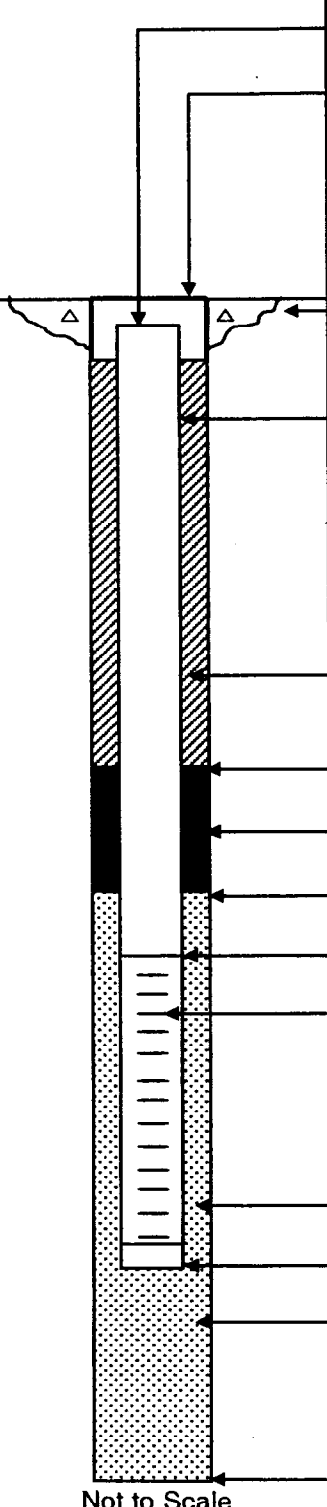
## MONITORING WELL SHEET

WELL No.: \_\_\_\_\_

PERMIT No.: \_\_\_\_\_

PROJECT:	<u>NTC GREAT LAKES</u>	DRILLING Co.:	_____	BORING No.:	_____
PROJECT No.:	<u>3939 CTO 154</u>	DRILLER:	_____	DATE COMPLETED:	_____
SITE:	<u>SITE 7</u>	DRILLING METHOD:	_____	NORTHING:	_____
GEOLOGIST:	_____	DEV. METHOD:	_____	EASTING:	_____

Ground Elevation Datum:



Not to Scale

Elevation / Depth of Top of Riser:	_____ / _____
Elevation / Height of Top of Surface Casing:	_____ / _____
I.D. of Surface Casing:	_____
Type of Surface Casing:	<u>FLUSH MOUNT</u>
Type of Surface Seal:	<u>CONCRETE</u>
I.D. of Riser:	<u>2"</u>
Type of Riser:	_____
Borehole Diameter:	_____
Type of Backfill:	<u>CEMENT GROUT</u>
Elevation / Depth of Seal:	_____ / _____
Type of Seal:	_____
Elevation / Depth of Top of Filter Pack:	_____ / _____
Elevation / Depth of Top of Screen:	_____ / _____
Type of Screen:	_____
Slot Size x Length:	<u>10'</u>
I.D. of Screen:	<u>2"</u>
Type of Filter Pack:	<u>No. 10-20 SAND</u>
Elevation / Depth of Bottom of Screen:	_____ / _____
Elevation / Depth of Bottom of Filter Pack:	_____ / _____
Type of Backfill Below Well:	_____
Elevation / Total Depth of Borehole:	_____ / _____



## MONITORING WELL MATERIALS CERTIFICATE OF CONFORMANCE

Well Designation: \_\_\_\_\_

Site Name: \_\_\_\_\_

Date Installed: \_\_\_\_\_

Project Name: \_\_\_\_\_

Site Geologist: \_\_\_\_\_

Drilling Company: \_\_\_\_\_

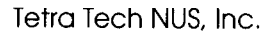
Driller: \_\_\_\_\_

Project Number: \_\_\_\_\_

Material	Brand/Description	Source/Supplier	Sample Collected ?
Well Casing			
Well Screen			
End Cap			
Drilling Fluid			
Drilling Fluid Additives			
Backfill Material			
Annular Filter Pack			
Bentonite Seal			
Annular Grout			
Surface Cement			
Protective Casing			
Paint			
Rod Lubricant			
Compressor Oil			

To the best of my knowledge, I certify that the above described materials were used during installation of this monitoring well.

Signature of Site Geologist: \_\_\_\_\_



## MONITORING WELL DEVELOPMENT RECORD

Well: \_\_\_\_\_ Depth to Bottom (ft.): \_\_\_\_\_ Responsible Personnel: \_\_\_\_\_  
 Site: SITE 7-RTC SILK SCREENING AREA Static Water Level Before (ft.): \_\_\_\_\_ Drilling Company: \_\_\_\_\_  
 Date Installed: \_\_\_\_\_ Static Water Level After (ft.): \_\_\_\_\_ Project Name: NTC GREAT LAKES  
 Date Developed: \_\_\_\_\_ Screen Length (ft.): \_\_\_\_\_ Project Number: 3939 CTO 154  
 Dev. Method: Surged & Pumped One Well Volume (gal/L): \_\_\_\_\_ PID Readings: Bore Hole \_\_\_\_\_ ppm  
 Pump Type: \_\_\_\_\_ Casing ID (in.): 2 inch PVC PID Readings: Breathing Zone \_\_\_\_\_ ppm

[illegible]

## GROUNDWATER LEVEL MEASUREMENT SHEET

**Project Name:** NTC GREYAK LAKES

**Project No.:** N3939 CTO 0154

**Location:** GREAT LAKES, ILLINIOS

**Personnel:****Weather Conditions:****Measuring Device:** M-Scope

**Tidally Influenced:** Yes \_\_\_\_ No \_\_\_\_

**Remarks:**[illegible]



Tetra Tech NUS, Inc.

## GROUNDWATER SAMPLE LOG SHEET

Page \_\_\_\_ of \_\_\_\_

Project Site Name: \_\_\_\_\_ NTC GREAT LAKES  
Project No.: \_\_\_\_\_ N3939 CTO 0154

☐ Domestic Well Data  
☒ Monitoring Well Data  
☐ Other Well Type: \_\_\_\_\_  
☐ QA Sample Type: \_\_\_\_\_

Sample ID No.: \_\_\_\_\_  
Sample Location: \_\_\_\_\_  
Sampled By: \_\_\_\_\_  
C.O.C. No.: \_\_\_\_\_  
Type of Sample: \_\_\_\_\_  
☒ Low Concentration  
☐ High Concentration

## SAMPLING DATA:

Date:	Color	pH	S.C.	Temp.	Turbidity	DO	ORP	ODOR
Time:	Visual	Standard	mS/cm	°C	NTU	mg/l		
Method:								

## PURGE DATA:

Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Flow Rate
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material								
Type: 2" PVC								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

## SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected
TCL Volatiles	HCl / 4C	(2) 40 ML VIALS	
TCL Semivolatiles	4C	(1) 1 L AMBER	
TAL Metals			
Cyanide			
Ethyl Acetate, Ethyl Alcohol & Isopropyl Alcohol			
ISOPROPYL ACETATE & n-PROPYL ACETATE			

## OBSERVATIONS / NOTES:

--	--

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):





## LOW FLOW PURGE DATA SHEET

**PROJECT SITE NAME:** NTC GREAT LAKES  
**PROJECT NUMBER:** N3939 CTO 0154

WELL ID.: \_\_\_\_\_  
DATE: \_\_\_\_\_

[illegible]

**SIGNATURE(S):** \_\_\_\_\_

**PAGE**      **OF**

Project Site Name: NTC GREAT LAKES

Project No.: N3939 CTO 154

Sample ID No.:

**Sample Location:** \_\_\_\_\_

Sampled By: \_\_\_\_\_

C.O.C. No.:

## Stream

**Spring**

**Pond**

▮ Lake

☐ Other: \_\_\_\_\_

QA Sample Type: \_\_\_\_\_

**Type of Sample:**

☐ Low Concentration

**High Concentration**

### SAMPLING DATA:

Date:	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	Salinity %	Other NA
Time:								
Depth:								
Method:								

**SAMPLE COLLECTION INFORMATION:**[illegible]**OBSERVATIONS / NOTES:**

### MAP:

**Circle if Applicable:**

MS/MSD

**Duplicate ID No.:**

**Signature(s):**

Project Site Name: NTC GREAT LAKES		Sample ID No.: _____		
Project No.: N3939 CTO 154		Sample Location: _____		
<input type="checkbox"/> Surface Soil		Sampled By: _____		
<input type="checkbox"/> Subsurface Soil		C.O.C. No.: _____		
<input type="checkbox"/> Sediment		Type of Sample: _____		
<input type="checkbox"/> Other: _____		<input type="checkbox"/> Low Concentration		
<input type="checkbox"/> QA Sample Type: _____		<input type="checkbox"/> High Concentration		
<b>GRAB SAMPLE DATA:</b>				
Date: _____	Depth: _____	Color: _____	Description (Sand, Silt, Clay, Moisture, etc.): _____	
Time: _____				
Method: _____				
Monitor Reading (ppm): _____				
<b>COMPOSITE SAMPLE DATA:</b>				
Date: _____	Time: _____	Depth: _____	Color: _____	Description (Sand, Silt, Clay, Moisture, etc.): _____
Method: _____				
Monitor Readings (Range in ppm): _____				
<b>SAMPLE COLLECTION INFORMATION:</b>				
Analysis	Container Requirements	Collected	Other	
<b>OBSERVATIONS / NOTES:</b>			<b>MAP:</b>	
<b>Circle if Applicable:</b>			<b>Signature(s):</b>	
MS/MSD	Duplicate ID No.: _____			



Tetra Tech NUS, Inc.

## DAILY ACTIVITIES RECORD

**PROJECT NAME:** NTC GREAT LAKES **PROJECT NUMBER:** N3939 CTO154  
**CLIENT:** NAVY **LOCATION:** \_\_\_\_\_  
**DATE:** \_\_\_\_\_ **ARRIVAL TIME:** \_\_\_\_\_  
**Tt NUS PERSONNEL:** \_\_\_\_\_ **DEPARTURE TIME:** \_\_\_\_\_  
**CONTRACTOR:** \_\_\_\_\_ **DRILLER:** \_\_\_\_\_

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

**COMMENTS:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**APPROVED BY:** \_\_\_\_\_

Tt NUS REPRESENTATIVE

DRILLER

DATE: \_\_\_\_\_

## HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

**Tetra Tech NUS, Inc.**

PROJECT NAME: ..... WELL/BORING NO.: .....

**PROJECT NO.:** ..... **GEOLOGIST:** .....

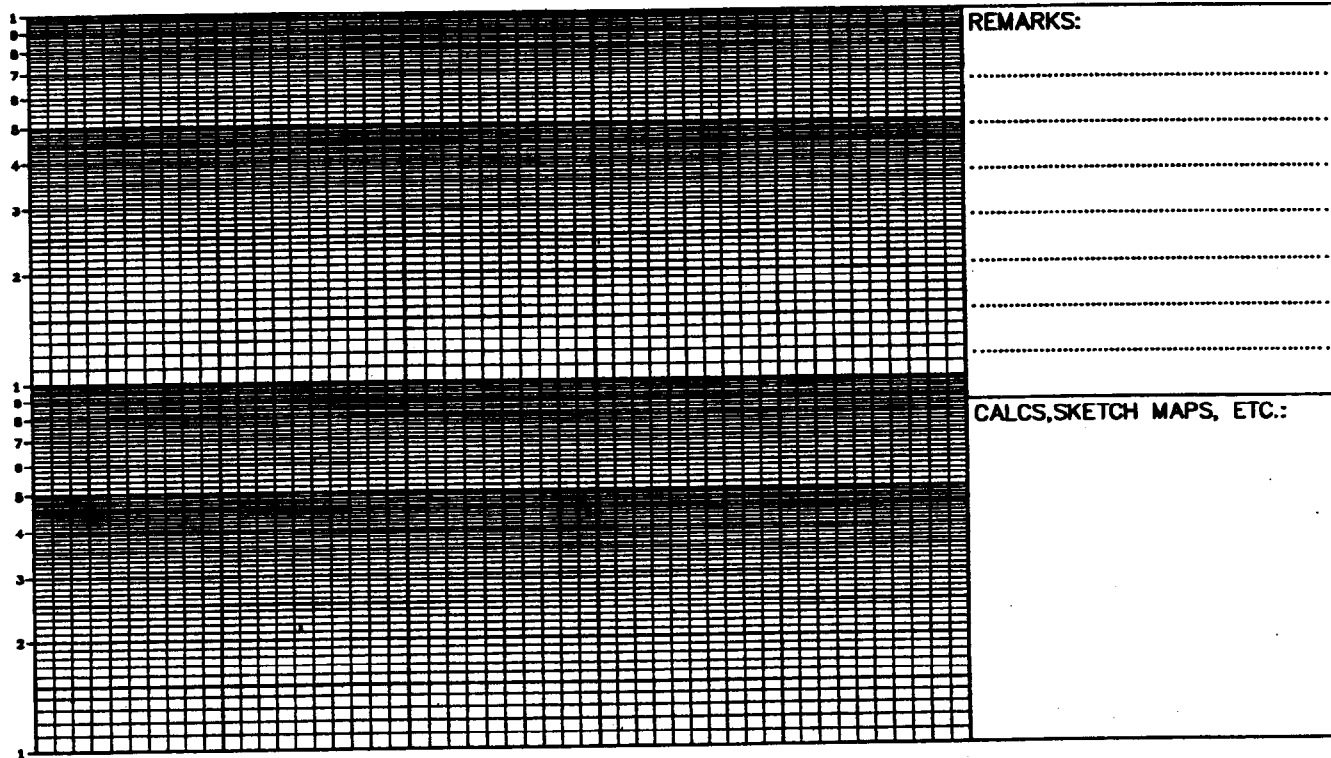
WELL DIAMETER: ..... SCREEN LENGTH/DEPTH: ..... TEST NO.: .....

STATIC WATER LEVEL (Depth/Elevation): ..... DATE: .....

TEST TYPE (Rising/Falling/Constant Head): ..... CHECKED: .....

METHOD OF INDUCING WATER LEVEL CHANGE: ..... PAGE .... OF .....

REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): .....

[illegible]

## **APPENDIX B**

### **STANDARD OPERATING PROCEDURES**

<u>SOP Number</u>	<u>Title</u>
CTO 154-1	Measurement of Water Levels in Monitoring Wells
CTO 154-2	Monitoring Well Purging and Stabilization
CTO 154-3	Monitoring Well Sampling
CTO 154-4	Surface Water Sampling
CTO 154-5	Sediment Sampling
CTO 154-6	Surface and Subsurface Soil Sampling
CTO 154-7	Drilling, Monitoring Well Installation, and Development
CTO 154-8	Decontamination of Field Sampling Equipment
CTO 154-9	Sample Identification Nomenclature
CTO 154-10	Field Documentation
CTO 154-11	Sampling Handling
CTO 154-12	Use of Photoinization Detector
CTO 154-13	Borehole and Soil Sampling Logging
CTO 154-14	Use of Water Quality Meter
CTO 154-15	Hydraulic Conductivity Testing

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-1**

## **MEASUREMENT OF WATER LEVELS IN MONITORING WELLS**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for determining water levels in monitoring wells.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

The following equipment and field forms are required for determining water levels in monitoring wells.

**Ground Water Level Measurement Form:** A copy of the Ground Water Level Measurement Form is included in Appendix A.

**Bound Field Log Book**

**Photoionization detector (PID):** The manual for the operation of the PID is found in the site-specific Health and Safety Plan (HASP).

**Well key**

**Electronic water level indicator:** The water level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 feet.

**Decontamination supplies:** SOP 8 describes decontamination procedures including decontamination supplies.



### **3.0 WATER LEVEL MEASUREMENT PROCEDURES**

- 3.1 Check the operation of the electronic water level indicator.
- 3.2 Record the well identification (ID), date, and time (using military time) on the Ground Water Level Measurement Form. A copy of this form can be found in Appendix A.
- 3.3 Unlock the well and remove the well cap.
- 3.4 Place the well cap on a clean piece of plastic.
- 3.5 Check the well for the presence of organic vapors in the 2-inch PVC riser pipe as follows:
  1. Calibrate the PID in accordance with the calibration procedures described in SOP 12.
  2. Insert the PID sample inlet straw approximately three inches into the riser pipe.
  3. Record the PID reading on the Ground Water Level Measurement Form. If the reading is below concentrations specified in the site-specific HASP, proceed to step 3.6. If the reading is above the concentration specified in the HASP, measure the concentration in the breathing zone. If the concentration in the breathing zone is below the concentration specified in the HASP, proceed to Step 3.6. If the reading is above the specified concentration, allow the riser pipe to ventilate for ten minutes and repeat the measurement of breathing zone concentrations until the concentrations fall below the level specified in the HASP before proceeding to step 3.6.
- 3.6 Insert the water level meter probe. (The probe must be decontaminated before use according to the procedures in SOP 8).
- 3.7 Slowly lower the probe into the well riser pipe until an audible and/or visible signal is produced, indicating contact with the water surface.
- 3.8 Read the ground water level measurement from the top of the inner casing at the surveyed reference point to the nearest 0.01 foot.
- 3.9 Record the water level measurement on the Ground Water Level Measurement Form.

- 3.10 Wind the meter cable measuring tape back onto the spool.
- 3.11 Replace the well cap and lock.
- 3.12 Decontaminate the meter's probe following the procedures outlined in SOP 8.
- 3.13 Containerize any decontamination fluids and PPE in accordance with the procedures described in Section 2.13 of this approved Supplemental Field Sampling Plan.

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-2**

## **MONITORING WELL PURGING AND STABILIZATION**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for well purging and stabilization utilizing low-flow techniques. Low-flow purging and stabilization techniques will be used for ground water sampling at Site 7 – RTC Silk Screening Shop.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

The following field forms and equipment are required for low-flow purging.

**Low-Flow Purge Data Form:** A copy of this form is included in Appendix A.

**Ground Water Sample Log Form:** A copy of this form is included in Appendix A.

**Bound Field Log Book**

**Photoionization detector (PID):** The manual for the operation of the PID is found in the Health and Safety Guidance Manual and in SOP 12.

#### **Well key**

**Electronic water level indicator:** The water level indicator must have a cable of sufficient length to reach the water surface and be capable of measurements of 0.01 feet. General instructions for operation of electronic water level indicators are supplied by the vendor and in SOP CTO 154-1.

**Multiple parameter water quality meter:** This unit measures and displays field parameters measured in the field including pH, dissolved oxygen, turbidity, oxidation-reduction potential (ORP), temperature, and

specific conductance. The manual for operation and calibration of this unit will be supplied by the vendor and is also in SOP CTO 154-14.

**Flow-through cell adapter for water quality meter**

**Purge water containers:** Plastic containers with lids.

**Graduated cylinder and stopwatch:** Used to calculate flow rate.

**Decontamination supplies:** SOP CTO 154-8 describes required decontamination supplies.

**Pump:** Peristaltic requires battery, and silicone tubing and Teflon lined tubing. Bladder pump requires compressed nitrogen and electronic programmable controller.

### **3.0 PUMP SELECTION FOR PURGING AND SAMPLING MONITORING WELLS**

Ground water monitoring wells will be purged and sampled using one of two pumping methods. Either a peristaltic pump or bladder pump will be used for all monitoring well purging and sampling. The method chosen will be based on the depth below ground surface (BGS) to water, and the recharge rate of the well. For a monitoring well having a depth to water equal to or greater than 20 feet BGS, a bladder pump will be used. For a monitoring well having a depth to water of less than 20 feet BGS and a recharge rate greater than 150 mL per minute, a peristaltic pump will be used. Prior to purging and sampling all monitoring wells will be developed, the recharge rate for each well will be determined during well development.

#### **3.1 PERISTALTIC PUMP METHOD**

Insert a new section of medical grade silicone tubing (approx. 18" in length) into the pump head, following the pump operation manual. Obtain the total depth of the well and screen length. Wear clean, disposable surgical gloves while handling the tubing. Measure the appropriate length of Teflon lined PE tubing and insert the tubing inlet (bottom of pump tubing) to the center of the saturated well screen. Insert the Teflon lined PE tubing into the silicone tubing. Proceed to section 4.0.

#### **3.2 BLADDER PUMP METHOD**

Obtain the total depth of the well and screen length. Calculate the length of tubing needed to position the inlet screen of the pump at the center of the saturated well screen. Wear clean, disposable surgical

gloves while handling the pump assembly and tubing. Measure the appropriate length of Teflon lined PE pump tubing and attach it to the bladder pump, examine all fittings and connections for tightness.

Insert the pump into the PVC riser pipe of the well. While holding the tubing, slowly lower the pump, taking care not to kink the pump tubing. When the tubing is inserted to it's complete length, suspend the pump and tubing assembly on the top of the riser pipe using the attached well cap assembly. The manual for the operation of the controller will be supplied by the vendor. Proceed to Section 4.0.

**Cylinder of compressed nitrogen with regulator:** Compressed gas serves as the power source for the bladder pump.

**Twelve-Volt Battery:** A 12-Volt battery (car or NiCd) may serve as a power source for the peristaltic pump.

#### **4.0 PROCEDURES FOR WELL PURGING**

- 4.1 Prior to mobilizing to the site, clean, check for proper operation, and calibrate water quality meter as per manufacture requirements and SOP CTO 154-14.
- 4.2 Follow steps 3.1 through 3.9 in SOP CTO 154-1 to obtain a static water level measurement of the well to be purged. Record the information on the Ground Water Sample Log Form and the Low-Flow Purge Data Form. Leave the water level meter suspended in the well casing.
- 4.3 Calculate one well casing volume as follows:
  1. Obtain the total depth of the well
  2. Using the static water level determined in 3.2 and the total depth of the well, calculate the well casing volume using the following formula:

$$V = (0.163)(T)(r^2)$$

where:

V	=	Static casing volume of well in gallons.
T	=	Length of water table in feet (linear feet of water).
0.163	=	A constant conversion factor which compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.
R	=	Inside radius of the well casing in inches

Note: For wells of 2-inch radius (4-inch diameter) the conversion factor is 0.652 gallons per foot of water column.

Bladder Pump only 4.4 and 4.5.

- 4.4 Connect the pump controller to the well pump air supply (at the well cap) by following the instructions in the pump control manual (a copy of the manual will be supplied by the vendor). The pump controller must be turned off when being connected.
- 4.5 Connect the nitrogen cylinder to the pump controller. The nitrogen cylinder valve must be closed and the regulator line pressure set at zero pounds per square inch (PSI) when being connected.
- 4.6 Following the instructions found in the water quality meter manual, connect the flow-through cell to the pump discharge line.
- 4.7 Place the discharge tubing from the flow-through cell to direct the purge water discharge into the graduated cylinder or purge-water container.
- 4.8 Following the instructions in the pump manual, start pumping water from the well.
- 4.9 Start with the initial pump rate set at approximately 0.1 liters/minute. Use the graduated cylinder and stopwatch to measure the pumping rate. Adjust pumping rates as necessary to prevent drawdown from exceeding 0.3 feet during purging. If no drawdown is noted, the pump rate may be increased (to a max of 0.4 liters/minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs. If ground water is drawn down below the pump intake or the top of the well screen (if the static water level is above the screen), purging will cease and the well will be allowed to recover before purging continues. Slow recovering wells will be identified and purged at the beginning of the workday. If possible,

samples will be collected from these wells within the same 8-hour workday and no later than 24 hours after the start of purging.

The time to sample any given well will vary greatly due to the many variables associated with low flow purging and sampling i.e.:

- Stabilization of parameters
- Possible draw down
- Analytical requirements
- Varying QA sample requirements
- Variable pump rates

Normally, the time from the start of purging to the end of sampling will be between 1.5 to 4.0 hours.

- 4.10 Measure the well water level using the water level meter every five to ten minutes. Record the well water level on the Low-Flow Purge Data Form.
- 4.11 Record on the Low-Flow Purge Data Form every five to ten minutes the water quality parameters (pH, specific conductance, temperature, turbidity, ORP, and dissolved oxygen) measured by the water quality meter. Clean the flow through cell as needed during purging (e.g., when fluctuating turbidity readings are observed and confirmed by collection of a turbidity sample before the cell for comparison). If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form.
- 4.12 Measure the flow rate using a graduated cylinder. Remeasure the flow rate any time the pump rate is adjusted.
- 4.13 During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles would be an indication that connections are not tight. If bubbles are observed, check for loose connections.

- 4.14 Stabilization is achieved and sampling can begin when a minimum of one casing volume has been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits:

pH  $\pm$  0.1 standard units  
Specific conductance  $\pm$  3%  
Temperature  $\pm$  3%  
Turbidity less than 10 NTUs  
Dissolved oxygen  $\pm$  10%

If the above conditions have not been met after the well has been purged for four hours, purging will be considered complete and sampling can begin.



## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-3**

#### **MONITORING WELL SAMPLING**

##### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for monitoring well sampling. Low-flow sampling techniques will be used for ground water sampling at Site 7 – RTC Silk Screening Shop.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

##### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

The following field forms and equipment are required for low-flow sampling of monitoring wells.

**Ground Water Sample Log Form:** A copy of this form can be found in Appendix A.

**Bound Field Log Book**

**Labeled sample containers:** See SOP CTO 154-9 for sample identification procedures.

**Peristaltic Pump or Bladder pump:** See SOP CTO 154-2 on purging for pump selection.

**Electronic Programmable Controller, model 400:** The programmable controller regulates the dedicated bladder pump. The manual for the operation of the controller will be supplied by the vendor.

**Cylinder of compressed nitrogen with regulator:** Compressed gas is the power source for the bladder pump.

**Twelve-Volt Battery:** A 12-volt battery (car or NiCd) may be used as a power source for the peristaltic pump.

## **Plastic storage bags**

## **Shipping containers**

### **3.0 MONITORING WELL SAMPLING PROCEDURES**

- 3.1 Prior to sampling the well the water level measurements described in SOP CTO 154-1, and the well purging procedures described in SOP CTO 154-2 must be completed. Samples are identified by an alpha-numeric naming convention described in SOP CTO 154-9. Initiate sampling when the well is stabilized in accordance with SOP CTO 154-2.
- 3.2 Record the sample start time (using military time) on the Ground Water Sample Log Sheet.
- 3.3 With the pump continuing to run, disconnect the flow-through cell from the pump discharge tube and immediately start filling sample bottles directly from the pump discharge. Allow the pump discharge to flow gently down the inside of the container with minimal turbulence when filling sample containers. Avoid immersing the discharge tube into the sample as the sample container is being filled.
- 3.4 Cap each container immediately after filling.
- 3.5 Record the sample time on the Ground Water Sample Log Form and the sample label. Additional sample documentation is discussed in SOP CTO 154-10.
- 3.6 Place the sample container into a plastic storage bag and then into a cooler containing ice.
- 3.7 Repeat steps 3.3 through 3.7 for each sample container collected.
- 3.8 The pump rate should not be adjusted after sampling has commenced. If it becomes necessary to adjust the pump rate, document the change on the Ground Water Sample Log Form.
- 3.9 All samples will be collected into pre-preserved bottles (if required) supplied by an approved laboratory. Table 2-2 of this approved Supplemental Field Sampling Plan includes information on preservation requirements. All samples will be collected in the following sequence (where applicable):

\*TCL VOCs (to include ethyl alcohol and ethyl acetate)

TCL SVOCs

TAL Metals

Cyanide

Total Organic Carbon (TOC)

\* When sampling with a peristaltic pump VOC's will be sampled last using the pipette (soda straw) method. The pipette VOC sampling method most often requires two people.

With the sample tubing full and the pump running on low (approx. 50 to 100 mL/min) remove the Teflon lined PE tubing from the silicone pump tubing and quickly place a gloved thumb over the end of the tubing. While holding and sealing the tubing end pull the pump tubing out of the well, this is accomplished by walking away from the well while the second person holds the tubing at the well head, using care to avoid contacting the ground with the tubing. When the end of the tubing has been removed from the well carefully hold it over an opened VOC vial, removing the thumb from the pump end of the tubing and gravity feed the sample into the vial (soda straw method). Reinsert the tubing into the well and pump until the tubing is full. Repeat as needed until all vials are full.

- 3.10 Sample containers for volatile constituents (VOCs) must be completely filled so that no headspace exists in the container.
- 3.11 Types of sample containers, sample volume, preservation requirements, and holding times are summarized in Table 2-2 of this Field Sampling Plan. All sample containers will be supplied by the laboratory, and the laboratory will pre-preserve all sample containers, where appropriate.
- 3.12 If the last turbidity measurement prior to the commencement of sampling showed turbidity to be greater than 10 Nephelometric Turbidity Units (NTUs), then filtered aliquots of ground water will be collected and analyzed for dissolved metals. Without turning off the pump, attach a disposable, inline, 0.45-um filter cartridge at the end of the discharge tube. Fill sample containers marked for "dissolved metals" so that the laboratory knows that these aliquots are distinct sample fractions and that the results should be reported as dissolved analytes.
- 3.13 Repeat steps 3.4 through 3.8 for the filtered sample containers.

- 3.14 After completion of sample collection: if using a peristaltic pump, pull tubing and properly dispose of tubing and filter following Section 2.13 (IDW disposal) in the FSP; for bladder pump remove pump from well and decontaminate following the procedures in SOP CTO 154-8. Replace the outer protective well cap and lock the well.
- 3.15 All equipment should be cleaned and packed into the sample vehicle, along with the sample cooler for transport.

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-4**

## **SURFACE WATER SAMPLING**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for surface water sampling. Surface water sampling will be collected at Site 17 – Pettibone Creek/Boat Basin.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

The following field forms and equipment are required for surface water and spring sampling.

**Surface Water Sample Log Form:** A copy of this form is included in Appendix A.

#### **Bound Field Log Book**

**Multi-parameter water quality meter:** The water quality meter is used for the measurement of dissolved oxygen, pH, specific conductance, temperature, turbidity, and oxidation-reduction potential. The procedures for the operation and calibration of this meter are provided in SOP CTO 154-14.

**Dedicated/disposable sample containers:** Dedicated/disposable sample containers are used to fill sample containers and transport sample(s) to a pump for filtering if dissolved samples are required.

**Labeled sample containers:** See SOP CTO 154-9 for sample identification procedures.

**0.45 micron filter assembly:** These are single-use filters used to filter samples. The filters are discarded after one use.

#### **Peristaltic pump + power source + tubing**

**Silicon tubing**

**Transfer bottles used during filtration**

**Plastic storage bags**

**Shipping containers**

### **3.0 SURFACE WATER SAMPLING PROCEDURES**

- 3.1 Sampling will start at the downstream location and proceed to the farthest upstream location. Reference figures are included in the FSP for approximate sample locations. The sampling sequence will be as follows:
- 3.2 Gently remove any leaves or twigs that have accumulated in the sample pool area
- 3.3 Estimate of the flow rate of the stream in gallons per minute (gpm) and note if base-flow (low-flow) or storm-flow (high-flow). This is an estimate only. Round the flow rate to the nearest five gallons and record this number on the Surface Water Sample Log Form.
- 3.4 Record the sample time (using military time) on the Surface Water Sample Log Form and sample container labels. Complete sample documentation of field activities in accordance with SOPs CTO 154-9 and CTO 154-10.
- 3.5 If the sample can be obtained from the shore, begin sampling using a dedicated, clean, unpreserved, one-liter collection bottle supplied by the laboratory. VOC's are an exception to this method, VOC's will be direct fill and completely filled so that no headspace exists in the container. Hold the collection bottle at a 45-degree angle and lower it to approximately half the sample pool depth. With the mouth of the bottle facing upstream, fill the collection bottle with water, being careful not to disturb the sediment.
- 3.6 If the sample cannot be obtained from the shore, carefully step into the water downstream of the sample location. Make certain that any disturbed sediment clears from the water before sampling. Begin sampling using a dedicated, clean, unpreserved, one-liter collection bottle supplied by the laboratory. Obtain the sample upstream of your location. Hold the collection bottle at a 45-degree

angle and lower it to approximately half the sample pool depth. With the mouth of the bottle facing upstream, fill the collection bottle with water, being careful not to disturb the sediment.

- 3.7 Transfer the contents of the collection bottle to the sample container and cap the sample container. Note, the unpreserved, one-liter collection bottle is needed for streams and surface water locations with low flow and/or shallow depths, that would prevent the complete filling of the sample container. Depending on site conditions, the sampler, may use either direct fill and/or a sample collection bottle (VOC are always direct fill).
- 3.8 Affix the sample label to the sample container.
- 3.9 Place the sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice.
- 3.10 Repeat steps 3.4 through 3.10 until all of the sample bottles have been filled.
- 3.11 All samples will be collected into pre-preserved bottles (if required for preservation) supplied by an approved laboratory. Table 2-2 of this approved Field Sampling Plan includes information on the preservative and bottle requirements. All samples will be collected in the following sequence (where applicable):

TCL VOCs

TCL SVOCs

TAL Metals (total and dissolved for surface water samples)

TCL Pesticides

TCL PCBs

- 3.12 Sample containers for volatile constituents (VOCs) must be filled directly from the surface water body (using no transfer bottle) completely filled so that no headspace exists in the container.
- 3.13 Fill two 1-liter unpreserved polyethylene bottles. Use these bottles to transfer sample for field filtering. Set up a peristaltic pump (see vendor-supplied manual) for filtering of the dissolved metals (Appendix IX and miscellaneous) and dissolved cyanide samples. Using dedicated and disposable silicone tubing and a 0.45 micron filter, place the intake tubing from the pump into the

transfer bottle with the filter attached to the discharge end and start the pump. Pre-rinse the filter with approximately 100-mL of sample water prior to filling the sample containers.

- 3.14 All samples will be collected into pre-preserved bottles (if required for preservation) supplied by an approved laboratory. Table 2-2 of this approved Field Sampling Plan includes information on preservative requirements.
- 3.15 Obtain measurements of dissolved oxygen, pH, specific conductance, temperature, turbidity, and oxidation-reduction potential using the multi-parameter water quality meter. Suspend the meter into the sample pool. After the meter has stabilized (approximately 1 to 2 minutes), record the readings on the Surface Water Sample Log Form.
- 3.16 Clean all equipment and load the equipment and the sample cooler in the sample vehicle for transport.



## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-5**

## **SEDIMENT SAMPLING**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish the procedure for sediment sampling. Sediment sampling will be collected at Site 17 – Pettibone Creek/Boat Basin.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

The following field forms and equipment are required for sediment sampling.

**Sample Log Form:** A copy of this form is included in Appendix A.

**Bound Field Log Book**

**Stainless steel and/or disposable plastic trowels**

**Survey Stakes and Flagging:** Used to mark sampling locations after completion of sampling.

**Labeled sample containers:** See SOP CTO 154-9 for sample identification procedures.

**Plastic storage bags**

**Shipping containers**

### **SEDIMENT SAMPLE LOCATION SELECTION**

Sediment samples are usually collected at the same verticals at which water samples were collected. The shape, flow pattern, depth, and water circulation patterns must all be considered when selecting sediment sample locations. In streams, areas likely to have sediment accumulation (e.g., bends, behind boulders, quite shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (e.g., high-velocity, turbulent areas) and suspension of fine solid materials, shall be avoided. In general bed sediments composed of fine-grained materials with lower porosity and greater surface area available for adsorption, are more desirable for sample selection. Bottom sediments (especially fined-grained materials) may act as a sink or reservoir for adsorbing heavy metals and organic contaminants (even if water column concentrations are below detection limits). Therefore, it is important to minimize the loss of low-density "fines" during the sampling process.

### **3.0 SEDIMENT SAMPLING PROCEDURES**

- 3.1 Wearing clean disposable, surgical gloves and using a sampling trowel clear any accumulated vegetative mater from the sample area. Using the trowel to scoop the sediment into the labeled sample container, carefully decant any water that may have accumulated, from the sample container. Be sure not to include twigs, leaves, or large pebbles in the sample. Inert pebbles and organic detritus will be removed from the sample by hand before the sample bottle is sealed and shipped to the laboratory.
- 3.2 Record the sample time (using military time) on the Sediment Sample Log Form and sample container labels.
- 3.3 Place the sample container into a plastic storage bag and then place the plastic storage bag holding the sample container into a cooler containing ice. Samples will be identified using procedures in SOP 09 and field activities documented in accordance with SOP CTO 154-10.
- 3.4 Using an indelible marker write the sample ID on a survey stake, drive the stake into the ground at the sample location.
- 3.5 All samples will be collected into bottles supplied by an approved laboratory. Table 2-1 of this approved Field Sampling Plan includes information on the bottle requirements. All samples will be collected in the following sequence (where applicable):

TCL VOCs

TCL SVOCs

TAL Metals  
TCL Pesticides  
TCL PCBs  
Polynuclear Hydrocarbons (PAHs)  
Total Organic Carbon (TOC)  
AVS / SEM  
pH

- 3.6 Sample containers for volatile constituents (VOCs) must be completely filled so that no headspace exists in the container.
- 3.7 Clean all equipment and load the equipment and the sample cooler in the sample vehicle for transport.

## **STANDARD OPERATING PROCEDURE**

### **CTO 154 SOP 6**

## **SURFACE AND SUBSURFACE SOIL SAMPLING**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for surface and subsurface soil sampling using direct push technology, split-barrel or hand auger for the Risk Assessment Work Plan at Site 7- RTC Silk Screening Shop and Site 17-Pettibone Creek/Boat Basin at NTC Great Lakes. This procedure also describes the collection of samples for Volatile Organic analysis and the use of field screening to select the most appropriate subsurface soil interval for sampling.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

**Writing utensil**

**Disposable Medical-Grade Gloves (i.e. latex, nitrile)**

**Boring Log**

**Sample Logsheets**

**Stainless-steel mixing bowls**

**Stainless-steel trowel or soup spoon**

**EnCore Handle and Sampler**

**Required sample containers with appropriate preservative:** All sample containers for analysis by fix-based laboratories will be supplied and deemed certified clean by the laboratory.

**Required Decontamination Materials**

**Bentonite Chips**

**Custody Seals**

**Chain of custody records**

**Required Personnel Protective Equipment (PPE)**

**A random number generator**

**Photoionization Detector (PID)**

**Wooden Stakes or Pin Flags**

**Sealable Polyethylene bags**

**Heavy-Duty Cooler**

**Ice**

### **3.0 COLLECTING SOIL SAMPLES FOR VOLATILE ORGANIC COMPOUNDS (VOCs)**

Soil samples collected for volatile organics will be obtained using a hermetically sealed sample vial such as an EnCore sampler and preserved in the laboratory (not in the field) with either methanol or sodium bisulfate dependent upon expected levels of contamination. The sample is collected by pushing the EnCore sampler directly into the soil core (before mixing in bowl), ensuring that the sampler is packed tight with soil, and leaving no headspace between cap and container. Four EnCore containers should be collected for each VOC sample. Using this type of sampling device eliminates the need for field preservation. Once the sample is collected, it should be kept at 4°C and shipped to the laboratory for preservation or extraction within 48 hours.

### **4.0 SURFACE SOIL COLLECTION**

Field screening of surface soils is not required. Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.). Regardless of collection method, samples for volatile organic analysis (VOCs) will be collected from the 6" to 1 foot interval. All other inorganic parameters for surface soil samples will be collected from the 0 to 6" interval. VOC containers are collected directly from the spoon, tube or auger without mixing. All other parameters will be collected after mixing of the interval.

### **5.0 SCREENING OF SUBSURFACE INTERVAL FOR SAMPLING**

Field screening methods may be used to select the appropriate subsurface soil interval for sampling of volatile organics for laboratory analysis. The objective of screening is to select for laboratory analysis, the contaminated (elevated volatiles or staining) or most relevant subsurface soil interval (above the surficial aquifer) for use in the risk assessment. All non-organic analysis will be collected from a soil composite. The maximum depth of a soil boring is 10 ft bgs or to the presence of saturated soil indicating the surficial aquifer. Since the surface interval extends from 0-1 feet bgs, a 1-foot soil interval must be selected from the bottom of the surface interval to the bottom of the soil boring (1-10 ft bgs).

Risk assessment requires identification of the most contaminated soil interval for VOC sampling. Assuming that the presence of volatile organic contaminants is an indicator of other contaminants, a

photoionization detector (PID) will be used to screen soil corings for the interval with the highest volatiles. Visual observation of soil discoloration or staining may also be used to select the contaminated soil interval. In the selection of soil intervals for sampling, elevated volatiles as measured by a PID, have priority over the visual observation of impacts. The other analytical properties will be collected from a composite of the subsurface soil.

If the most contaminated interval may not be identified, as above, then it is assumed that the most relevant subsurface interval for risk assessment is the one-ft interval above the uppermost (surficial) aquifer. Saturated conditions indicate the presence of a surficial aquifer and therefore without PID or visual clues of contamination, the interval for sampling will be the interval above the uppermost aquifer. Standing water in an open borehole or saturated conditions in corings indicates a surficial aquifer. Measurements of volatiles with a PID or visual observations of impacts have priority over the use of saturated conditions to identify the interval for sampling.

In the absence of either elevated volatile organics, visual clues of impacts, or surficial aquifer, a random subsurface interval is selected for representative sampling. If screening is negative above this randomly chosen interval, VOCs samples must be collected from this random interval before screening can resume on cores below this interval. If screening below this interval is negative, samples for other constituents may be collected from this random interval after mixing. If screening below this random interval indicates impacts (volatiles, staining, saturation), the random interval is ignored (samples discarded) and new samples should be collected from contaminated or relevant interval.

Since samples for VOC analysis must be collected soon after retrieval and corings from DPT/Drilling are retrieved in 4 ft sections, the outcome of screening in lower, as yet unretrieved intervals, may impact early decision made in upper levels. Therefore it may be necessary to collect extra VOC samples that will not be analyzed. Unused filled EnCore sample containers that will not be analyzed, will be emptied, washed and discarded as trash.

Screening criteria for selection of sample interval is prioritized in the following list:

1. Highest total VOC measurement by Photoionization Detector;
2. Visual Observation of Contamination including discoloration, staining, or others;
3. Interval above the uppermost surficial aquifer; and
4. Random interval.

The process for screening soil corings to select the most contaminated, relevant or representative subsurface interval is as follows:

- Prior to the start of the subsurface soil boring/probing, a random soil interval will be identified (2-4, 4-6, 6-8, 8-10, etc.). A roll of a die can be used. Samples will be collected from this random interval if no volatile organics are measured, no staining is observed, or no water table is detected
- Scan the length of the core interval for elevated volatile organics, visual signs of contamination, or saturated layers of soil. Field screening takes precedence over the random interval. If screening criteria are not identified, VOC samples must be collected from the random interval before proceeding to screen lower intervals of the core boring.
- Collect VOC samples from the selected interval with the following priority:
  - If elevated volatile organics are measured via the PID, collect the necessary VOC samples from this interval and continue to scan.
  - If visual signs of contamination (staining, etc.) are observed, but no volatiles, then collect the necessary VOC samples from the stained interval and continue to scan.
  - If a saturated layer of water is observed but no volatiles or staining, then collect VOCs from the first unsaturated one-ft interval above the saturated layer and stop.
  - If no elevated PID measurements, staining or groundwater are noted, collect the VOC sample from the random interval, and save the core for possible sampling. Continue to scan the core with the PID.
  - Continue this process, collecting VOC samples at suspect intervals until refusal, the water table or the bottom depth of 10' is reached.
- Composite and mix soils for other analytes from the entire soil boring. Assure to omit any saturated soil in the composite.
- Record the sample time on the Soil (and Sediment) Sample Log Sheet and on the sample label.

- Place the sample in a plastic storage bag and then into a cooler containing ice. Package and ship samples according to SOP CTO 154-11.

## **7.0 DIRECT PUSH TECHNOLOGY (DPT)**

DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no drill cuttings.

### **7.1 SAMPLING EQUIPMENT**

Additional equipment needed for conducting DPT probing for soil sampling includes, but is not limited to, the following:

- 4-foot X 1.5-inch diameter macro-core sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Acetate liner for soil sampler
- Steel drive points
- Geoprobe AT-660 Series Large Bore Soil Sampler, or equivalent

### **7.2 DPT SAMPLING METHODOLOGY**

There are several methods for the collection of soil samples using DPT probing equipment. The most common method is explained in the following section. Variations of the following method may be conducted upon approval of the Project Manager.

- Macro-core samplers fitted with detachable steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material.
- The sampler is advanced continuously in 4-ft intervals. No soil cuttings are generated because the soil is displaced within the formation.



- The sampler is retracted from the hole, and the 4-ft continuous sample is removed from the outer coring tube. The sample is contained within an acetate liner.
- Log the sample on the Boring Log Sheet. Note: the DPT macro-core sampler is 4' in length and sample length is 1' use a engineer's tape to measure for sample intervals.
- The acetate liner is cut lengthwise in order to field screen the sample with a PID, visually observe the sample for staining, assess moisture content, and if sampling criteria are met, mixing and transfer the sample to sample containers for laboratory analysis.
- Record the sample time on the Soil (and Sediment) Sample Log Sheet and on the sample label.
- Place the sample in a plastic storage bag and then into a cooler containing ice. Package and ship samples according to SOP CTO 154-11.
- If additional sample volume is required, push an additional boring adjacent to the first and composite/mix the same interval.

Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.

## **8.0 SOIL SAMPLING USING A HAND AUGER**

A hand augering system generally consists of a variety of all stainless steel bucket bits (i.e., cylinders 6-1/2 " long and 2-3/4", 3-1/4", and 4" in diameter), a series of extension rods (available in 2', 3', 4', and 5' lengths), and a cross-handle. The hand auger can be used in a wide variety of soil conditions. It is limited in depth of boring by texture of soil, layers of rock, or collapse of borehole by saturated conditions.

### **8.1 HAND AUGERING EQUIPMENT**

To accomplish soil sampling using a hand augering system, the following additional equipment is required:

- Complete hand auger assembly (including clips to attach auger bucket and handle to extension).

## 8.2 HAND AUGERING METHODOLOGY

To obtain soil samples using a hand auger, the following procedure shall be followed:

- Clear the area to be sampled of any surface debris (herbaceous vegetation, twigs, rocks, litter, etc.).
- Attach a properly decontaminated bucket bit to a clean extension rod and further attach the cross handle to the extension rod.
- Begin augering by turning the "T" handle in a clock-wise fashion, thus turning the auger bit until the bucket bit is advanced approximately 6 inches into the soil. Remove the bucket from the borehole, empty the contents and repeat, adding additional rod extensions as necessary to reach the desired depth.
- After reaching the desired depth, slowly and carefully withdraw the bucket from the borehole.
- Discard the top of core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the desired sample depth.
- Utilizing the hand trowel remove the sample material from bucket bit into a properly decontaminated stainless steel mixing bowl.
- Screen the auger interval for volatiles, staining, or saturation per procedure and collect surface or subsurface samples based on procedure.
- Log the recovered sample on the Boring Log sheet (provided in Appendix A).
- Return the same bucket auger into the borehole and turn the auger, advancing the auger bit an additional 6 inches into the soil (totaling 1 foot).
- After reaching the desired depth, slowly and carefully withdraw the bucket from the borehole.
- Discard the top of core (approximately 1"), which represents any loose material collected by the bucket bit before penetrating the desired sample depth and repeat the field screening to identify the interval to be sampled.

- After the VOC samples have been collected, using a decontaminated stainless-steel trowel or soup spoon, thoroughly mix (homogenize) the sample material (which now contains a 1-foot interval of sample) in the mixing bowl and fill the appropriate sample bottle(s).
- If additional sample volume is required, auger adjacent to the initial boring and composite/mix soil from the same interval.
- Fill out a soil sample logsheet (found in Appendix A) and sample labels (according to SOP CTO 154-10) making sure that the appropriate fields are filled out completely and legibly and affix them to the sample bottle.
- Proceed with handling each sample container.
- Place the sample container into a plastic storage bag and then into a cooler containing ice.
- Once sampling has been completed, the hole is backfilled with bentonite chips

## **9.0 SOIL SAMPLING WITH A HOLLOW STEM AUGER AND A SPLIT BARREL SAMPLER**

A split-barrel (split spoon) sampler consists of a heavy stainless steel sampling tube that can be split into two equal halves to reveal the soil sample. Carbon steel split spoons cannot be used for soil sampling. A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is attached to a drill rod and forced into the ground by means of a 140-lb or larger casing driver.

### **9.1 HOLLOW STEM SAMPLING EQUIPMENT**

The following additional equipment is used for obtaining a split-barrel sample:

- Drilling Equipment (provided by subcontractor)
- Stainless steel Split Barrel Samplers (OD 2", I.D. 1-3/8", either 20" or 26" long)
- Drive weight assembly, 140-lb weight, driving head and guide permitting free fall of 30".

## 9.2 SPLIT SPOON SAMPLING METHODOLOGY

The drilling subcontractor will usually provide the recovered spoon or barrel to the sampler and the following steps shall be used to obtain the collect the soil sample:

- Once the drive head and nosepiece is removed, open the sampler to reveal the soil sample. Immediately scan the sample core with the PID and visually for staining or saturation per procedure. Carefully separate the soil core, with a decontaminated stainless steel utensil at about 6-inch intervals while scanning the center of the core for elevated readings or staining. Record readings and observations.
- Select the sample interval per procedure.
- Collect the volatile sample from an undisturbed area of the interval (i.e., the center of the core) where scanning indicates layers of interest.
- Utilizing the hand trowel remove the sample material from the spoon or barrel into a properly decontaminated stainless steel mixing bowl. Mix thoroughly and collect samples for other analytes.
- Record the sample time on the Soil (and Sediment) Sample Log Sheet and on the sample label.
- Place the sample in a plastic storage bag and then into a cooler containing ice. Package and ship samples according to SOP CTO 154-11.
- If additional sample volume is required, auger an additional boring adjacent to the initial borehole and composite/mix the same interval. Do not collect soil for chemical analysis from the auger flights.
- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-7**

## **MONITORING WELL INSTALLATION AND WELL DEVELOPMENT**

### **1.0 PURPOSE**

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development. The methods described herein are specific for monitoring well construction at Site 7- RTC Silk Screening Shop. Guidelines by South Division, Naval Facilities Engineering Command, (South Div NavFac, 1997) should be consulted as should State of Illinois regulatory requirements in Illinois Water Well Construction Code of Section 920.90 (77 Ill. Adm. Code 920).

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 RESPONSIBILITIES**

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The rig geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

Site Safety Officer - The Site Safety Officer is responsible for clearing the drill site for underground and overhead utilities or other potentially hazardous obstructions.

### **3.0 REQUIRED EQUIPMENT/ITEMS**

The following list includes equipment and items required for monitoring well installation:

- Health and safety equipment as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).

### **4.0 WELL DESIGN**

The objectives of monitoring well locations are to evaluate ground water quality of various locations in relation to their historical extent and to determine flow direction.

Well construction is tailored to the specific objective of the monitoring well. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- Historical geologic logs describing the depth, thickness and uniformity of the water-bearing zone or strata of interest;
- The presence and location of contaminants encountered during drilling; and
- Whether the purpose of the installation is for evaluating the groundwater quality of the uppermost surficial aquifer is being investigated.

In most situations depending on the purpose of the well and the site conditions, monitored intervals are 10 feet and will be installed with approximately 8 feet of the screen located below the water table. Shorter screen lengths (5 feet) are usually required where shallow surficial aquifers are being monitored. Bottoms of well screens should be placed a minimum of 6 inches but no more than 3 ft above the bottom of the drilled borehole.

All monitoring wells will be constructed of schedule-40, flush-joint threaded, 2-inch ID PVC riser pipe and flush joint threaded, factory slotted well screen with a threaded end cap. The well screens will be factory slotted to 0.010-inch size. Each section of well casing and screen shall be National Sanitation Foundation (NSF) approved. Well screens will be 10-feet long, but may be longer or shorter based on the subsurface conditions encountered. A PVC cap will be placed on the bottom and are also flush threaded. Thermoplastic pipe shall comply with ASTM F-480 (1981). Other means of joining casings using glue, gaskets, pop rivets or screws are not allowed.

The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The field geologist shall specify the combination of screen slot size and sand pack, which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells.

The hollow-stem auger dry drilling method will be used to install most monitoring wells. The augers will have a 4.25 inch inside diameter and create a 9.5 inch borehole. The use of drilling fluids will not be permitted. If used, split-spoon samples will be collected in accordance with ASTM specification D1586-84. Split-spoon samplers will be of 2-inch or 3-inch diameter and 2-foot minimum length. Samples will typically be collected continuously to the water table or as determined by the field geologist. Every effort will be made to achieve maximum recovery of sample material during split-spoon sampling, including use of traps as needed.

Monitoring wells will be installed through the augers immediately upon completion of each well boring. A clean silica sand pack will be installed through the augers as they are removed from the boring. Clean silica sand of U.S. Standard Sieve Size No. 20 to 40 will be used. The sand pack will be extended from 0.5 feet below the well screen to 2.0 feet above the top of the well screen. A minimum 2-foot thick bentonite pellet seal will be installed above the sand pack and allowed to hydrate as per the manufacturer's recommendations. Only 100-percent, certified pure, sodium bentonite will be used for well construction. The depths of backfill materials will be constantly monitored during well installation using a weighted stainless steel or fiberglass tape measure. The remaining annulus above the hydrated bentonite seal will be backfilled to the surface using a tremie pipe, with a 20:1 cement/bentonite grout. A maximum of 10 gallons of water per 94-pound bag of Type-1 cement will be used. The grout mixture should be blended in an above-ground rigid container or mixer to produce a thick lump-free mixture.

As required in the Navy Guidelines, a minimum 1-ft thick secondary filter pack will be used to prevent intrusion of the bentonite seal into the primary filter pack. Uniformly graded fine sand with 100% by weight

passing the No. 30 U.S. Standard sieve, and less than 2% by weight passing the 200 U.S. Standard sieve should be used as a secondary filter pack.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets extending to the surface. The grout effectively seals the well and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom of the hole upward, to prevent bridging, and to provide a better seal. However, in shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

When the well is completed and grouted to the surface, a protective flush mount steel vault is placed over the top of the well. The finished well casing shall be installed flush with the ground level and must be equipped with a watertight cap. This casing will have a cap that can be locked to prevent vandalism. The protective vault has a larger diameter than the well and is set into the wet cement grout over the well upon completion.

#### **4.1 MONITORING WELLS IN UNCONSOLIDATED SEDIMENTS**

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe is lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur.



After the sand pack (primary and secondary) is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent) can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack.

The cement-bentonite grout is then mixed and either poured or tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed.

#### **4.2 CONFINING LAYER MONITORING WELLS**

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between the unconfined and confined aquifer. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 3 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting the outer casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for installation of the monitoring well as detailed for overburden monitoring wells (with the exception of not using a temporary casing during installation). Sufficient time (determined by the rig geologist) must be allowed for setting of the grout prior to drilling through the confined layer.

#### **4.3 DOCUMENTATION OF FIELD ACTIVITY**

A critical part of monitoring well installation is recording of significant details and events in the site logbook, on field forms, and a field logbook. Details of borehole and soil sample logging are contained in SOP CTO154-13, and field documentation procedures are outlined in SOP CTO 154-10.

#### **5.0 WELL DEVELOPMENT METHODS**

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, specific conductance, turbidity, and temperature taken during development yield information (stabilized values) that sufficient development is reached. Development should proceed until criteria are met as stated in Navy Guidelines.

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is used to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

Development should proceed until the following criteria are met:

1. The well water is clear to the unaided eye AND
2. A minimum removal of five times the standing water volume in the well (to include the well screen and casing plus saturated borehole annulus, assuming 30% annular porosity) OR
3. When pH measurements remain constant within 0.1 Standard Units and specific conductance and temperature vary no more than plus or minus 3% for at least three consecutive readings. Turbidity should also show stabilization and ideally be below 10 Nephelometric Turbidity Units (NTUs).

If for any reason the above criteria cannot be met, the site geologist should document the event in writing and consult with the TOM regarding an alternate plan of action.

Well development must be completed at least 24 hours before well sampling. The intent of this hiatus is to provide time for the newly installed well and backfill materials to sufficiently equilibrate to their new environment and for that new environment to re-stabilize after the disturbance of drilling.

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-8**

## **DECONTAMINATION OF FIELD SAMPLING EQUIPMENT**

### **1.0 PURPOSE**

The purpose of this procedure is to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, soil and sediment sampling equipment, surface water sampling equipment and monitoring well sampling equipment

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 GLOSSARY**

**Liquinox** - A brand of phosphate-free laboratory-grade detergent.

**Deionized Water** - Deionized (analyte free) water is tap water that has been treated by passing through a standard deionizing resin column. Deionized water should contain no detectable heavy metals or other inorganic compounds at or above the analytical detection limits for the project.

**Potable Water** - Tap water used from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

**Solvent** - The solvent of choice is pesticide-grade Isopropanol. Solvents should not be used on PVC equipment or well construction materials.

### **3.0 RESPONSIBILITIES**

**Project Manager** - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standard Operating Procedures, or as otherwise dictated by the approved project plan(s).

#### **4.0 PROCEDURES**

To ensure that analytical chemical results reflect actual contaminant concentrations present at sampling locations, the various drilling equipment, and chemical sampling and analytical equipment used to acquire the environmental sample must be properly decontaminated. Decontamination minimizes the potential for cross-contamination between sampling locations, and the transfer of contamination off site.

##### **4.1 DRILLING EQUIPMENT**

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental samples. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.). In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens. Downhole equipment, however, must always be steam-cleaned between borings. Where PVC well casings are to be installed, decontamination is not required if the manufacturer provides these casings in factory-sealed, protective plastic sleeves (so long as the protective packaging is not compromised until immediately before use). Guidance to be used when decontaminating drilling equipment shall include:

As a general rule, any part of the drilling rig, which extends over the borehole, shall be steam cleaned.

All drilling rods, augers, and any other equipment, which will be introduced to the hole, shall be steam cleaned.

The drilling rig, all rods and augers, and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned, as practicable. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

## **4.2 DECONTAMINATION PAD CONSTRUCTION**

The steam cleaning area shall be designed to contain decontamination wastes and waste waters and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided which is connected to a holding facility. A shallow aboveground tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate decontamination area. Alternately, a lined sloped pad with a collection pump installed at the lower end may be permissible. The location of the steam cleaning area shall be onsite in order to minimize potential impacts at certain sites.

## **4.3 GROUND WATER SAMPLING EQUIPMENT**

When collecting environmental samples from monitoring wells at NTC Great Lakes, several types of sampling devices may be employed. The type of sampling equipment used, depending on well depth, water level, and/or cost will be a peristaltic pump, bladder pump, or bailer (stainless steel or Teflon).

### **4.3.1 Sampling Equipment**

Before the initial sampling and after each successive sampling point, sampling equipment (augers, split spoons, bowls, soup spoons, bailers, etc.) must be decontaminated. The following steps are to be performed when sampling for organic and inorganic contaminants:

- Potable water rinse
- Liquinox detergent wash-Includes scrubbing of the equipment with a scrub brush (may be required if the sample point is heavily soiled with heavy or extremely viscous materials)
- Potable water rinse
- Deionized water rinse
- Pesticide-grade isopropanol (only when oily soil conditions are encountered)
- Copious Deionized water rinse

- Air dry

Only reagent grade or purer solvents are to be used for decontamination. When solvents are used, the sampling equipment must be thoroughly dry before using to acquire the next sample.

In general, specially purchased pre-cleaned disposable sampling equipment is not decontaminated (nor is an equipment rinsate blank collected) so long as the supplier has provided certification of cleanliness. If decontamination is performed on several pieces of equipment at once (i.e., in batches), equipment not immediately used may be completely wrapped in aluminum foil (shiny-side toward equipment) and stored for future use. When batch decontamination is performed, one equipment rinsate is generally collected from one of the pieces of equipment belonging to the batch before it is used for sampling.

#### **4.3.2     Sampling Pumps**

Sampling pumps are low volume (less than 0.5 gpm) pumps. These include peristaltic and bladder pumps. If these pumps are used for sampling from more than one sampling point, they must be decontaminated prior to initial use and after each use.

The following procedures shall be adhered to when decontaminating sampling pumps:

Bladder pumps- Each of the liquid fractions are to be pumped through the system; the 10 percent nitric acid solution is omitted. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge tubing.

Peristaltic pumps- All contamination is confined to the tubing, therefore the tubing is discarded and replaced with new tubing.

#### **4.4        OTHER SAMPLING EQUIPMENT**

Field tools such as trowels and mixing bowls are to be decontaminated in the same manner as described in Section 4.3.1 of this SOP.

#### **4.5        WATER LEVEL INDICATORS**

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

Rinse with potable water

Rinse with deionized water

#### **4.6 PROBES**

Probes (e.g., pH or specific-ion electrodes, geophysical probes, or thermometers) which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise (e.g., dissolved oxygen probes). Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, (e.g., OVA equipment) the probe is self-cleaning when exposure to uncontaminated air is allowed and the housing can be wiped clean with paper-towels or a cloth wetted with alcohol.

#### **5.0 WASTE HANDLING**

For the purposes of these procedures, contaminated materials are defined as any byproducts of field activities that are suspected or known to be contaminated with hazardous substances. These byproducts include such materials as decontamination solutions, purge water, soil cuttings, well-development fluids, and spill-contaminated materials. All of the above wastes will be handled following the procedures outlined in Section 2.13 of the Supplemental FSP.

As a general policy, it is wise to select investigation methods that minimize the generation of contaminated spoils and investigation derived wastes. Handling, decontaminating and disposing of potentially hazardous spoils and wastes can be dangerous and expensive. Until sample analysis is complete, it is assumed that all produced materials are suspected of contamination from hazardous chemicals and require containment.

**STANDARD OPERATING PROCEDURE**  
**SOP CTO 154-9**  
**SAMPLE IDENTIFICATION NOMENCLATURE**  
**AT**  
**NTC GREAT LAKES**

**1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish a consistent sample nomenclature system that will facilitate subsequent data management at the Naval Training Center (NTC) Great Lakes. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by site, location or matrix.
- Maintenance of consistency (field, laboratory, and data base sample numbers).
- Accommodation of all project-specific requirements.
- Accommodation of laboratory sample number length constraints.
- Ease of identification and direct link to site and year.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

**2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

**Pen with indelible ink**

**Sample container labels**

**3.0 SAMPLE IDENTIFICATION NOMENCLATURE**

**3.1 Monitoring Sample**

All monitoring samples collected at NTC Great Lakes will be properly labeled with a sample label affixed to the sample container. Each sample will be assigned a unique sample tracking number. The sample tracking number will consist of a five or six segment alpha-numeric code that identifies the project (NTC),



sample's associated site, sample type, location, and, for aqueous samples where applicable, whether a sample is filtered and/ or the sample round number.

The alphanumeric coding to be used in the NTC Great Lakes sample system is explained in the diagram and the subsequent definitions:

<b>Project Prefix</b>	<b>NN</b>	<b>AA</b>	<b>A or N 2 to 5- Characters</b>	<b>NN and/or A Aqueous only</b>	<b>NNNN Soils and Sediment only</b>
NTC	Site Number	Sample Type	Location	Round Identifier and/or Filtered	Depth Interval

**Character Type:**

A = Alpha  
N = Numeric

**Site Number:**

Monitoring locations at the two sites. The site IDs of the two units are:

07 = RTC Silk Screening Area Site 07  
17 = Pettibone Creek/Boat Basin Site 17

Field sampling operations for the above sites are currently in progress or are expected to take place. For future sites or site numbers refer to the appropriate planning documents for the proper numbers.

**Sample Type:**

GW = Ground water sample  
SD = Sediment sample  
SW = Surface water sample  
SB = Soil Boring sample  
SS = Surface soil sample

**Location:**

The sample location code is the well number, the soil sample location, sediment sample location, or the stream sample location (i.e., surface water, springs, or seeps).

02 = Soil Boring Location 02.  
01 = Monitoring well 01.  
12 = Sediment sample 12.

Note: To keep the sample identification nomenclature to a minimum numbers of characters and to avoid redundancy, MW (monitoring well) is used for text, figures and tables and replaced with GW (groundwater) in the sample identification, example MW01 would be GW01.

**Round Identifier:**

A two digit round identifier will be used to track the number of aqueous samples (GW, SW, RW, etc.) taken from a particular aqueous sample location. The first sample collected from a location will be assigned round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

**Filtered:**

Water samples that are field filtered (dissolved analysis) will be identified with an "F" in the last code section. No entry in this segment signifies an unfiltered (total) sample.

**Depth Interval, Soil and Sediment only:**

The depth code is used to note the depth, below ground surface (bgs), at which a soil or sediment sample is collected. The first two numbers of the four number code specify the top interval and the third and fourth specify the bottom, feet bgs (soil) inches bgs (sediment) of the sample. The depths will be noted in whole numbers only, further detail if needed will be recorded on the sample log sheet, boring log, log book, etc.

**Depth (for soils, in feet bgs):**

0002 = soil collected from 0 to 2 foot bgs  
0204 = soil collected from 2 to 4 feet bgs  
0810 = soil collected from 8 to 10 feet bgs, etc.

**Depth interval:**

01 = sediment collected from 0 to 1.5 inches bgs  
02 = sediment collected at 1 foot bgs  
03 = sediment collected from 1.5 inches to 3 feet bgs  
04 = sediment collected from 3 to 6 feet bgs  
05 = sediment collected from 6 to 10 feet bgs

### **3.1.1      Examples of Sample Nomenclature**

The first ground water sample collected from newly installed monitoring well 07MW01 at the RTC Silk Screening Area (Site 07) for a filtered sample would be designated as NTC07GW0101F.

The second ground water sample collected from newly installed monitoring well 07MW04 at the RTC Silk Screening Area (Site 07) for an unfiltered sample would be designated as NTC07GW0402.

The first unfiltered ground water sample collected from new monitoring well 07MW03 at the RTC Silk Screening Shop (Site 07) would be designated as NTC07GW0301.

The first surface water sample collected from location 01 at Pettibone Creek (Site 17) for an unfiltered sample would be designated as NTC17SW0101.

The surface soil sample collected from soil boring 01 at the RTC Silk Screening Shop (Site 07) would be designated as NTC07SS010002.

The subsurface soil sample collected from the same soil boring at an interval of 4 to 5 feet bgs would be designated as NTC07SB010405.

A sediment sample collected at Pettibone Creek at 1 foot at location 23 would be designated as NTC17SD2302.

A sediment sample collected at the Boat Basin from 0 to 1.5 inches at location 14 would be designated as NTC17SD1401.

A sediment sample collected at the Boat Basin from 3 to 6 feet at location 10 would be designated as NTC17SD1004.

### **3.2      Field Quality Assurance/Quality Control (QA/QC) Sample Nomenclature**

Field QA/QC samples are described in the approved Field Sampling Plan and QAPP. They will be designated using a different coding system. The QC code will consist of a four to five-segment

alphanumeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC collected on that date.

<b>Project Prefix</b>	<b>AA</b>	<b>NNNNNN</b>	<b>NN</b>	<b>F</b>
NTC	QC Type	Date	Sequence Number (per day)	Filtered (aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank

RB = Rinsate Blank (Equipment Blank)

FD = Field Duplicate

AB = Ambient Conditions Blank

SO = Source Water Blank

The sampling time recorded on the chain-of-custody form, and labels and for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory).

### **3.2.2 Examples of Field QA/QC Nomenclature**

The first duplicate of the day for a filtered ground water sample obtained on June 3, 2001 would be designated as NTCFD06030101F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003 would be designated as NTCFD11170303.

The first Trip Blank associated with samples collected on October 12, 2001 would be designated as NTCTB10120101.

The only Rinsate Blank collected on November 17, 2001 would be designated as NTCRB11170101.

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-10**

#### **SAMPLE CUSTODY AND DOCUMENTATION OF FIELD ACTIVITIES**

##### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish the procedures for sample custody and documentation of field sampling and field analyses activities.

The Naval Training Center (NTC) Great Lakes Environmental Protection Department must approve any deviations from this procedure.

##### **2.0 FIELD FORMS LIST**

The following log books, forms, and labels are required.

**Site Log Book**

**Field Log Book**

**Sample labels**

**Chain-of-Custody**

**Custody seal**

**Equipment Calibration Log Sheet**

**Boring Log**

**Monitoring Well Construction Form**

**Monitoring Well Certificate of Conformance**

**Monitoring Well Development Record Form**

**Water level Measurement Form**

**Low Flow Purge Data Form**

**Ground Water Sample Log Form**

**Surface Water Sample Log Form**

**Soil Sample Log Sheet**

**Daily Activity Record Form**

**Hydraulic Conductivity Testing Data Sheet**

### **3.0 PROCEDURES**

This section describes custody and documentation procedures. All entries made into the log books, custody documents, logs, and log sheets described in this SOP must be made in indelible ink (black is preferred). No erasures are permitted. If an incorrect entry is made, the entry shall be crossed out with a single strike mark, initialed, and dated.

#### **3.1 SITE LOG BOOK**

The site log book is a hardbound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded (daily) in the site log book:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of sampling activities
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues
- Weather conditions

The site log book is initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place.

The following information must be recorded on the cover of each site log book:

- Project name
- Project number
- Book number
- Start date
- End date

Information recorded daily in the site log book need not be duplicated in other field notebooks, but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks

for detailed information (where applicable). At the completion of each day's entries, the site log book must be signed and dated by the Field Operations Leader (FOL).

Upon completion of the fieldwork or when completely filled, the Site Log Book is stored in the NSWC Crane records repository.

### **3.2 FIELD LOG BOOKS**

The Field Log Book is a separate dedicated notebook used by field personnel, as needed, to document the activities in the field. This notebook is hardbound and paginated.

Upon completion of the fieldwork or when completely filled, Field Log Books are stored in the NTC Great Lakes records repository.

### **3.3 SAMPLE LABEL**

Adhesive sample container labels must be completed and applied to every sample container. The following information will be printed on the labels prior to field activities: project number (CTO 154), project Location (NTC Great Lakes), sample ID, preservative, analysis to be performed, matrix type, and laboratory name.

### **3.4 CHAIN-OF-CUSTODY FORM**

The Chain-of-Custody (COC) is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. Each COC is numbered. This form must be used for any samples collected for laboratory chemical analysis. The original (top) signed copy of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. Once the samples are received at the laboratory, the sample custodian checks the contents of the cooler against the enclosed COC. Any problems are noted on the enclosed COC form (discrepancies between the sample labels, tags, COC form, etc.) and will be resolved through communication between the laboratory point-of-contact and the task manager. The laboratory will not unusual conditions of the received samples (cracked, broken, temperature, etc.) in the comment line of the COC, complete the Condition upon Receipt Variance form, and immediately notification of the task manager to discuss appropriate corrective action if samples are compromised (see Appendix D with the laboratory SOPs). Corrective actions will include resampling of the sample location if TtNUS is on-site or

the sample data will be lost if TtNUS has demobilized from the site. The COC form is signed and retained by the laboratory and becomes part of the sample's corresponding analytical data package.

Each COC is placed into a binder and stored in the NTC Great Lakes records repository. Appendix A contains an example COC.

### **3.5 CUSTODY SEAL**

The Custody Seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The Custody Seals are signed and dated by the samplers and affixed across the opening edges of each cooler (four seals per medium to larger coolers; two seals per small cooler) containing environmental samples. The laboratory sample custodian will examine the Custody Seal for evidence of tampering and will notify the task manager if evidence of tampering is observed.

### **3.6 EQUIPMENT CALIBRATION LOG**

The Equipment Calibration Log is used to document calibration of measuring equipment (e.g. multi-parameter water quality meter) used in the field. The Equipment Calibration Log documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device requiring calibration. Entries must be made for each day the equipment is used.

Each calibration log is placed into a binder and stored in the NTC Great Lakes records repository. Appendix A contains an example Equipment Calibration Log sheet.

A preprinted, fill-in the blank type, field form will be used to document each field task i.e. drilling, surface water sampling, sediment sampling etc. An example of all field forms can be found in Appendix A.

### **3.7 BORING LOG SHEET**

The Boring Log Sheet is used to document lithology encountered during advancement of the boring. This sheet is used in conjunction with the borehole advancement procedures outlined SOP CTO 154-7 and the lithologic documentation process outlined in SOP CTO154-13. Appendix A contains an example Boring Log Sheet.



### **3.8 MONITORING WELL CONSTRUCTION FORM**

The Monitoring Well Construction Form provides a detailed description of the construction of a monitoring well. Appendix A contains an example Monitoring Well Construction Form.

### **3.9 MONITORING WELL DEVELOPMENT RECORD FORM**

The Monitoring Well Development Record Form is used to document the development process of monitoring wells. Appendix A contains an example Monitoring Well Development Record Form.

### **3.10 WATER LEVEL MEASUREMENT FORM**

The Water Level Measurement Form is used to document synoptic water level measurements of monitoring wells and staff gauges. Appendix A contains an example Water Level Measurement Form.

### **3.11 LOW FLOW PURGE DATA FORM**

The Low Flow Purge Data Form documents the water quality parameters recorded during the purging of a monitoring well. Appendix A contains an example Low Flow Purge Data Form.

### **3.12 GROUNDWATER SAMPLE LOG FORM**

The Groundwater Sample Log Form is used to document the samples taken from groundwater location. The form includes information regarding the groundwater quality, monitoring well being sampled, and analytes being sampled. Appendix A contains an example Groundwater Sample Log Form.

### **3.13 SURFACE WATER SAMPLE LOG FORM**

The surface water sample Log Form is used to document the samples taken from surface water location. Appendix A contains an example Surface Water Sample Log Form.

### **3.14 SOIL SAMPLE LOG SHEET**

The soil sample Log Sheet is used to document the samples taken from each boring. Appendix A contains an example Soil Sample Log Sheet.

### **3.15 DAILY ACTIVITY RECORD FORM**

The Daily Activity Record Form is used to document a subcontractors day to day activities. Appendix A contains an example Daily Activity Record Form.

### **3.16 HYDRAULIC CONDUCTIVITY TESTING DATA SHEET**

The Hydraulic Conductivity Testing Data Sheet is used to document the data collected during a slug test. Appendix A contains an example Hydraulic Conductivity Testing Data Sheet.

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-11**

## **SAMPLE PRESERVATION, PACKAGING, AND SHIPPING**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures for sample preservation, packaging, and shipping to be used in handling environmental samples obtained for chemical analysis at NTC Great Lakes.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

**Shipping labels**

**Custody seals**

**Chain-of-custody (COC) forms**

**Sample containers with preservatives:** All sample containers for analysis by fixed-base laboratories will be supplied and deemed certified clean by the laboratory.

**Sample shipping containers (coolers):** All sample shipping containers are supplied by the laboratory.

**Packaging material:** Bubble wrap, ZipLoc bags®, strapping tape, etc.

**Temperature Blank**

### **3.0 PROCEDURES FOR SAMPLE PRESERVATION, PACKAGING, AND SHIPPING**

3.1 Tables 2-1 and 2-2 of this Field Sampling Plan (WP/FSP) establishes requirements for sample preservation. The laboratory provides sample containers that are certified clean for the analytical parameter for which the sample is to be analyzed. All samples will be held, stored, and shipped at  $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . This will be accomplished through refrigeration (used to hold samples prior to shipment) and/or ice.

3.2 The sampler shall maintain custody of the samples until the samples are relinquished to another custodian or to the common carrier.

- 3.3 Check that the sample container is properly identified on the label, the lid securely fastened, and the container sealed in a ZipLoc bag.
- 3.4 Place the sample container into a bubble-out shipping bag and seal the bag using the self-sealing, pressure sensitive tape supplied with the bag.
- 3.5 Inspect the insulated shipping cooler. Check for any cracks, holes, broken handles, etc. If the cooler has a drain plug, make certain it is sealed shut. If the cooler is questionable for shipping, the cooler must be discarded.
- 3.6 Place the sample container into a shipping cooler in an upright position (all containers, except VOC's will be upright for shipment). Continue filling the cooler with samples and packing material until the cooler is full and the movement of the sample containers is limited.
- 3.7 Place a temperature blank in the cooler.
- 3.8 Fill the voids in between the bubble-out shipping bags with ice and continue filling the cooler with ice to the top, using a minimum of eight pounds of ice for a medium-size cooler.
- 3.9 Complete a Chain of custody form. List on the COC each sample bottle contained in the cooler. Include the air bill number on the COC. Use a ballpoint pen and make sure that all of the carbon forms are legible.
- 3.10 Place the original (top) signed copy of the COC form, inside a large ZipLoc bag. Tape the bag to the inside of the lid of the shipping cooler.
- 3.11 Close the cooler and seal the cooler with approximately four wraps of strapping tape at each end of the cooler. Prior to wrapping the last wrap of strapping tape, apply a signed, and dated custody seal to each side of the cooler (a total of four signed custody seals must be used per cooler). Cover the custody seal with the last wrap of tape. This will provide a tamper evident custody seal system for the sample shipment.

- 3.12 Affix a shipping label to the top of the cooler containing all of the shipping information. Overnight (e.g. FedEx Priority Overnight) courier services will be used for all sample shipments. Include the air bill number on the COC.
- 3.13 All samples will be shipped to the laboratory no more than 72 hours after completion of sampling. Under no circumstances will sample holding times be exceeded for hold times (See Tables 2-1 and 2-2 of the WP/FSP).

- 3.14 Samples will be shipped to the following:

STL Pittsburgh  
450 William Pitt Way  
Pittsburgh, PA 15238

## STANDARD OPERATING PROCEDURE

### SOP CTO 154-12

## USE OF PHOTOIONIZATION DETECTOR

### 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish procedures for the use, maintenance, and calibration of the photoionization detector (PID). The Photovac 2020 Photoionization Air Monitor will be used for the Risk Assessment investigation. The procedures for its use are discussed in detail in the following sections.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### 2.0 GLOSSARY

Electron volt (eV) - A unit of energy equal to the energy acquired by an electron when it passes through a potential difference of 1 volt in a vacuum. It is equal to  $1.602192 \pm 0.000007 \times 10^{-19}$  volts.

Intrinsically Safe (I.S.) - Based on wiring, configuration, design, operation, gasketing, construction, this instrument may be employed within locations in which flammable gases and/or vapors may exist.

Ionization Potential (I.P.) - The energy required to remove an electron from a molecule yielding a positively charged ion and a negatively charged free electron. The instrument measures this energy level.

Photoionization Detector (PID) - Photoionization detector employed as general reference to air monitors of this type. PIDs detection method employs ultraviolet (UV) radiation as an energy source. As air and contaminant are drawn through the ionization chamber the UV light source causes the contaminant with ionization potentials equal to or less than the UV source to break into positive and negatively charge ions. The created ions are subjected to an electrostatic field. The voltage difference is measured in proportion to the calibration reference and the concentration of the contaminant.

Ultraviolet Radiation (UV) - Ultraviolet radiation is the energy source employed by the instrument to ionize collected sample gas streams. The UV lamp source is required to be equal to or greater than the ionization potential of the substance drawn through the instrument in order to create separate ionized species.

### **3.0 REQUIRED EQUIPMENT**

#### **Pen**

#### **Equipment Calibration Form**

### **4.0 PROCEDURES**

#### **4.1 PRINCIPLE OF OPERATION**

The Photovac portable photoionizer detects the concentration of many organic (and a few inorganic). The basis for detection of this instrument is the ionization of components of captured gaseous streams. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many gaseous compounds. Molecules are transformed into charged-ion pairs, creating a current between two electrodes. Each molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively-charged ion and the free electron. The instrument measures this energy level.

This instrument measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. It does not distinguish between individual substances. Readings displayed represent the total concentration of all photoionizable chemicals present in the sample. This instrument is factory set to display concentration in units of ppm or mg/m<sup>3</sup>. The meter display updates itself once per second.

2020 also performs short-term exposure limit (STEL), time-weighted average (TWA) and PEAK calculations. You can view any of these results, but only one mode may be viewed at a time.

2020 has 6 keys for alphanumeric entry and for accessing multiple functions. The keys are used to set up and calibrate 2020. They allow you to manipulate the concentration data in various ways.

All information entered with the keys and stored in 2020's memory is retained when the instrument is switched off. The clock and calendar continue to operate and do not need to be set each time 2020 is turned on.

#### **4.1.1      Displays**

The 2020 has a meter display for reporting detected concentration, and a display used to display status information and guide you through configuration options. All functions of the 2020 will be controlled or reported using one of these displays.

##### **4.1.1.1      Meter Display**

The meter display is a 4-digit display. It will always be used for reporting detected concentration. When the detector and pump are off, the meter display will be blank.

In order to accommodate the range of concentrations 2020 can detect, the meter reading will be reported using one of 2 resolutions. A resolution of 0.1 will be used for concentrations below 100 ppm, and a resolution of 1 will be used for concentrations above 100 ppm.

##### **4.1.1.2      Status Display**

The status display is a 2 line by 16 character display. The top line is used to display status information and prompts you for information. The bottom line is used for soft key names. Up to 3 names can be displayed for the 3 soft keys. If a name does not appear for a soft key, then the soft key has no associated function.

#### **4.1.2      Keys**

##### **4.1.2.1      Fixed Keys**

The three round keys below the soft keys each have a fixed function. The first key is the ON/OFF key, the middle key is the EXIT key, and the last key is the ENTER key.

The ON/OFF key is used to both turn power on to the 2020 as well as turn the power off. To turn on 2020, press the ON/OFF key. To turn the power off, press the ON/OFF key and hold it down for 2 seconds, and then release it. This is done to prevent accidental power off.



The EXIT key provides a way of returning to the default display. In the functional map, the soft keys allow you to advance and the EXIT key provides a way to go back. If you are at the initial entry of the menu, EXIT will return you to the default display.

The ENTER key has a context sensitive function. When you are operating or navigating through the function map, the ENTER key is used to exit the functions and return you to the default display. When entering data such as a name, number, date, or time, ENTER is used to confirm the entry.

#### **4.1.2.2 Soft Keys**

The three soft keys on 2020 are located directly below the status display. Each key has varying functions for configuring 2020, editing the data logger, and controlling the display. Since only three soft keys are available, each function is broken down into a path.

#### **4.1.2.3 Entering Text With the Soft Keys**

For all information that you must enter, the left, center, and right soft keys correspond to the up, down, and right arrow.

The up and down arrows are used to change the character highlighted by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right most character, it wraps around to the first character again. To accept the changes, press the ENTER key. To ignore the change, press EXIT.

Formatting characters, such as the colon (:) in the time, the decimal (.) in a concentration, and the slash (/) in the date are skipped when advancing the cursor.

All inputs are an 8 character input, which is displayed on the right side of the top line of the status display. The prompt, describing the input, occupies the left half of the top line. The soft keys are defined on the bottom line of the status display.

### **4.2 DEFAULT DISPLAY**

The meter display shows the detected concentration. The resolution of the display changes with the magnitude of the reading. A reading of 0 to 99.9 will be displayed with a resolution of 0.1 ppm or mg/m<sup>3</sup>.

A reading greater than 99.9 will be shown with a resolution of 1 ppm or mg/m<sup>3</sup>. The meter will display concentrations up to 2000 ppm or 2(XX) mg/m<sup>3</sup>.

The status display is used to display the instrument status, date, time, units, and active soft keys.

The default display provides the following information: instrument status, current detected concentration, time, date, and measurement units. The status display toggles between showing time and units and then the date.

When the display mode is MAX, the date and time correspond to the date and time the MAX concentration was recorded. In TWA mode, the time represents the number of hours and minutes during which the TWA has been accumulating. For PEAK and STEL monitoring, the date and time correspond to the current date and time.

## **4.3 MONITORING**

### **4.3.1 Instrument Status**

The instrument status is shown on the left of the first line of the status display and on the Table and Graph outputs. Each status has a priority assigned to it. If more than one status is in effect, then the status with the highest priority is displayed until the condition is corrected or until the option is turned off.

### **4.3.2 Alarms**

While operating the instrument, any one of three alarm conditions can occur. To accurately identify the source of the alarm, each type of alarm has been given a unique status.

In addition to the status, 2020 also has an audible alarm and a visual alarm LED. To conserve power, the 2020 alternates between these two alarm indicators, rather than operating both concurrently. Different alarms are identified by the frequency at which the 2020 alternates as follows: PEAK alarm-5 times per second; STEL alarm-2.5 times per second; and TWA alarm-1.25 times per second.

The left soft key is used for acknowledging alarms, and is named "Ack." If no alarm exists, then the "Ack" key is not shown. To clear the alarm, press the "Ack" key. Once acknowledged, the alarm indicators are cleared. The alarm status will remain until the alarm condition clears.

2020 updates the peak concentration once every second. Following every update, the peak concentration is compared to the peak alarm level, and if exceeded, an alarm is triggered.

If 15 minute average exceeds the selected STEL, a STEL alarm is generated.

The TWA alarm is generated when the current average of concentration, since the TWA was last cleared, has exceeded the TWA exposure limit.

During calibration, all alarms are disabled. Once the calibration is complete the alarms are re-enabled.

#### **4.4 STEL, TWA, MAX, AND PEAK OPERATION**

The 2020's meter display can be configured to show one of four values: STEL, TWA, PEAK, and MAX.

##### **4.4.1 Short-term Exposure Limit (STEL) Mode**

The Short-term Exposure Limit (STEL) mode displays the concentration as a 15 minute moving average. 2020 maintains 15 samples, each representing a one-minute averaging interval.

Once every minute, the oldest of the 15 samples is replaced with a new one minute average. This moving average provides a 15-minute average of the last 15 minutes with a one-minute update rate. Since the average is calculated using 15 one-minute averages, the meter display will only update once every minute.

STEL is set to zero each time the instrument is turned on. Since STEL is a 15-minute moving average, there is no need to clear or reset the STEL.

STEL calculations are always being performed by 2020. You can display the results of the calculations by selecting STEL as the Display mode.

##### **4.4.2 Time-weighted Average (TWA) Mode**

The TWA accumulator sums concentrations every second until 8 hours of data have been combined. If this value exceeds the TWA alarm setting, a TWA alarm is generated. The TWA is not calculated using a moving average. Once 8 hours of data have been summed, the accumulation stops. In order to reset the TWA accumulator, press the "Clr" key.

This sum will only be complete after 8 hours, so the meter displays the current sum divided by 8 hours. While you are in TWA mode, the time on the status display will show the number of minutes and hours of data that TWA has accumulated. When this reaches 8 hours 2020 stops accumulating data and the TWA is complete.

TWA calculations are always being performed by 2020. You can display the results of the calculations by selecting TWA as the Display mode.

#### **4.4.3     MAX Mode**

The MAX mode displays the maximum signal, with the date and time that it was recorded. 2020 continues to log data according to the selected averaging interval, but only the maximum detected concentration is displayed on the meter display.

The right soft key is used to clear the meter when displaying MAX. The "Clr" key only affects the reading that the meter is displaying. For example, if you display the MAX reading, and you press "Clr," only the MAX value is cleared. The TWA is still accumulating in the background.

#### **4.4.4     PEAK Mode**

The PEAK mode displays the current detected concentration. The reading is updated once a second. In the background, the 2020 data logger is sampling the concentration and measuring minimum, maximum, and average concentrations for the selected averaging interval. At the end of every interval, one entry is placed in the data logger until the data logger is full. Typical application concerning the use of this instrument is operated in this mode. Operation within the other specialized modes are the responsibility of the SSO.

### **4.5       SET FUNCTIONS**

Set functions are used to setup 2020. There are three functions which can be set on the 2020: Calibration, Pump and Clock.

#### **4.5.1     Pump**

The Pump function is used to control the pump. After selecting Set Pump, 2020 responds by displaying the new pump status.

The detector is also turned off when you turn the pump off. This prevents the detector from being damaged when there is no sample flowing through the detector.

When the pump and the detector are off, the meter display will be blank. Turn the pump and detector off when concentration measurements are not necessary, and 2020 will only be used for reviewing data or generating reports. By operating the instrument with the pump and detector off when you do not need them, you will conserve the lives of the battery and ultraviolet (UV) lamp.

1. Press the ENTER key. The top line of the status display changes to "Select?". The bottom line displays 3 soft key names: "Set," "Log," and "Disp."
2. Press the soft key below "Set."
3. The names of the soft keys change to reflect the Set options. The display now shows 3 devices which can be set: "Clock," "Pump," and "Cal." Press the "Pump" key.
4. The 2020 turns the pump off. If the pump was off, pressing "Pump" will turn the pump on.
5. A message will be displayed to show you the status of the pump. 2020 reverts back to the previous menu after a few seconds.
6. To return to the default display, press the ENTER key.

#### **4.5.2     Clock**

The Clock function is used to set both the current date and time.

1. Press the ENTER key.
2. Press the "Set" key.

3. When the names of the soft keys change, press the "Clock" key.  
The up and down arrows are used to change the character underlined by the cursor. The right arrow is used to advance the cursor to the next character on the right. When the cursor is advanced past the right-most character, it wraps around to the first character again.  
Formatting characters, such as the colon (:) in the time and the slash (/) in the date are skipped when advancing the cursor.
4. Use the "arrow keys" to enter the correct time. The time is formatted as Hour:Minute:Second.
5. Press the ENTER key to confirm the time and move to the date option.
6. When setting the date, the 2020 prompts you for the current date formatted as Year/Month/Day. Use the "arrow keys" to enter the correct date.
7. Press the ENTER key to confirm the date and return to the Set options. You can wait for the display to timeout or press ENTER to return to the default display.

#### **4.5.3     Calibration (Cal)**

Cal allows you to setup and calibrate 2020. You have three options under the Cal function: "Zero," "Span," and "Mem."

A calibration memory consists of a name, a response factor, and PEAK, TWA, and STEL alarm levels.

The "Zero" and "Span" keys are covered in detail in the manufacturer's operations manual for the instrument.

To edit the calibration memory, select "Mem" and then "Chng." The 2020 prompts you with two new soft keys: "User" and "Lib."

#### **4.5.4     Library (Lib)**

Library selections simplify Cal Memory programming, and provide standard response factors for approximately 70 applications. "Lib" allows you to select an entry from a pre-programmed library. The name, response factor, and three alarm levels are all set from the library. To select a library entry to program the selected Cal Memory:

1. Select "Set," "Cal," "Mem," "Chng," and "Lib."
2. Use the "Next" and "Prev" keys to scroll through the list. See the manufacturer's manual Appendix 8.7 for a list of the library entries.

#### **4.6 PREPARING FOR FIELD OPERATION OF THE PHOTOVAC 2020**

##### Turning 2020 On

1. Turn 2020 on by pressing the ON/OFF key.
2. 2020 will display the software version number. Wait for the 2020 to proceed to the default display.
3. Allow 10 minutes for the instrument to warm up and stabilize.
4. Press the Enter Key. The default display will provide 3 soft key selection "Set," "Log," and "Display."
5. Press "Set." From this option 3 other soft key selections will be offered: "Pump," "Clock," and "Cal."
6. Press "Cal." This will begin the calibration sequence. The first selection is to Zero the instrument.
7. Press Enter, zeroing will begin. (Note: When employing zero gas attach and activate zero gas supply at this time.)
8. The next selection offered will be Span. Press Enter at which time the concentration will be requested. The isobutylene calibration gas employed under general service will be marked on the side of the container. Use the soft keys to toggle into position and to log the concentration. Once the concentration is logged press "Enter." The direction or status display will indicate spanning. At this time hook up the span gas with a regulator to the Photovac 2020, and open it to supply enough flow to elevate the flow rate indicator to the green indicator line (1/8" from the rest position).

9. Once spanning is complete, the alarms which have been disabled during calibration will activate indicating that calibration is complete.
10. Document this calibration procedure using a Document of Calibration form (included in Appendix A).

This instrument is ready for general purpose application.

Calibration is to be performed daily or prior to each use in accordance with this section.

#### **4.7 Maintenance and Calibration Schedule**

<b>Function</b>	<b>Frequency</b>
Routine Calibration	Prior to each use
Factory Inspection and Calibration	Once a year, or when malfunctioning
Wipe Down the Outer Casing of the Unit	After each use
Clean UV Light Source	Every 24 hours of operation
Sample Inlet Filter	Change on a weekly basis or as required by level of use
Battery charging	After each use
Clean ionization chamber	Monthly

##### **4.7.1 Cleaning the UV Light Source Window**

1. Turn the FUNCTION switch to the OFF position. Use 2020 multi-tool and remove lamp housing cover.
2. Tilt the lamp housing with one hand over the opening, slide the lamp out of the housing.
3. The lamp window may now be cleaned with any of the following compounds using lens paper:
  - a. 11.7 eV Lamp - Dry Aluminum Oxide Powder (3.0 micron powder)
  - b. HPLC Grade Methanol - All other lamps
4. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using 2020 multi-tool. (Do not over tighten).



5. Recalibrate as per Section 4.6.

#### **4.7.2 Cleaning the Ionization Chamber**

1. Turn the FUNCTION switch to the OFF position and remove the lamp housing cover and lamp as per Section 4.7.1.
2. Using a gentle jet of compressed air, gently blow out any dust or dirt.
3. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Replace o-ring as necessary, reinstall lamp housing cover, tighten using 2020 multi-tool. (Do not over tighten).
4. Recalibrate as per Section 4.6.

#### **4.8 INSTRUMENT ADVANTAGES**

The Photovac 2020 is easy to use in comparison to many other types of monitoring instrumentation. Its detection limit range is in the low parts-per-million range. Response time rapidly reaches 90 percent scale of the indicated concentration (less than 3 seconds for benzene). This instrument's automated performance covers multiple monitoring functions simultaneously, incorporating data logging capabilities.

#### **4.9 LIMITATIONS OF THE PHOTOVAC 2020 PHOTOIONIZATION MONITOR**

- Since the 2020 is a nonspecific total gas/vapor detector, it cannot be used to identify unknown chemicals; it can only quantitate them in relationship to a calibration standard (relative response ratio).
- For appropriate application of the 2020, ionization potentials of suspected contaminants must be known.
- Because the types of compounds that the 2020 can potentially detect are only a fraction of the chemicals possibly present at a hazardous waste site or incident, a background or zero reading on this instrument does not necessarily signify the absence of air contaminants.

- The 2020 instrument can monitor only certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected.
- PID's are generally not specific. Their response to different compounds is relative to the calibration gas used. This is referred to as relative response ratio. Instrument readings may be higher or lower than the true concentration. This can be an especially serious problem when monitoring for total contaminant concentrations if several different compounds are being detected at once.
- The 2020 is a small, portable instrument which cannot be expected to yield results as accurately as laboratory instruments.

#### **4.9.1 Variables Affecting Monitoring Data**

Monitoring hazardous waste site environment can pose a significant challenge in assessing airborne concentrations and the potential threats to site personnel. Several variables may influence both dispersion and the instrument's ability to detect actual concentrations. Some of the variables which may impact these conditions are as follows:

- Temperature - changes in temperature or pressure will influence volatilization, and effect airborne concentrations. Additionally, an increase or decrease in temperature ranges may have an adverse effect on the instrument's ability to detect airborne concentrations.
- Humidity - excessive levels of humidity may interfere with the accuracy of monitoring results.
- Rainfall - through increased barometric pressure and water may influence dispersion pathways effecting airborne emissions.
- Electromagnetic interference - high voltage sources, generators, other electrical equipment may interfere with the operation and accuracy of direct-reading monitoring instruments.

#### **5.0 SHIPPING**

The Photovac may be shipped as cargo or carried on as luggage providing there is no calibration gas cylinder accompanying the kit. When shipping or transporting the calibration gas, a Hazardous Airbill must be completed.

## **6.0 REFERENCES**

Photovac 2020 Photoionization Monitor User's Manual, 1995.

**STANDARD OPERATING PROCEDURE**  
**SOP CTO 154-13**  
**BOREHOLE AND SOIL SAMPLE LOGGING**

**1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to describe the standard procedures and technical guidance on borehole and sample logging at NTC Great Lakes.

The NTC Great Lakes Environmental Protection Department must approve any deviations from this procedure.

**2.0 FIELD FORMS AND EQUIPMENT**

**Knife**

**Ruler (marked in tenths and hundredths of feet)**

**Boring Log**

**Writing utensil**

**Munsell Soil Color Book**

**3.0 RESPONSIBILITIES**

A field geologist/engineer is responsible for supervising all boring activities and assuring that each borehole is properly and completely

**4.0 PROCEDURES FOR BOREHOLE AND SAMPLE LOGGING**

To maintain a consistent classification of soil, it is imperative that the field geologist understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

**4.1 USCS CLASSIFICATION**

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

FIGURE 1

UNIFIED SOIL CLASSIFICATION (USCS)										
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)										
COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Sizes					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size					
			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)				GROUP SYMBOL	TYPICAL NAMES
					Identification Procedures on Fraction Smaller than No. 40 Sieve Size					
						DAY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
GRAVELS (50%(+)>1/4")	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.		Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.		Slight to Medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.	SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
SANDS 50%(+)<1/4")	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.		High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.		Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures.	HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other organic soils
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.						
Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder. All sieve sizes on this chart are U.S. Standard.										

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC. COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inch $\Phi$ -1/2 inch $\Phi$ )" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

#### **4.2 COLOR**

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

#### **4.3 RELATIVE DENSITY AND CONSISTENCY**

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere

well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined by hand by determining the resistance to penetration by the thumb. The thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample. The sample shall be broken in half and the thumb pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

**FIGURE 2**  
**CONSISTENCY FOR COHESIVE SOILS**

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

#### 4.4 WEIGHT PERCENTAGES

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

#### 4.5 MOISTURE

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

#### 4.6 SUMMARY OF SOIL CLASSIFICATION

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types



- Moisture content
- Other distinguishing features

#### 4.7 CLASSIFICATION OF SOIL GRAIN SIZE FOR CHEMICAL ANALYSIS

To determine the gross grain size classification (e.g., clay, silt, and sand) from the USCS classification described above, the following table shall be used.

Gross Soil Grain Size Classification	USCS ABBREVIATION	Description
Clay	CL	inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays,
	CH	inorganic clays of high plasticity, fat clays
	OH	organic clays of medium to high plasticity, organic silts
Silt	ML	inorganic silts and very fine sands, rock four, silty or clayey fine sands with slight plasticity
	OL	organic silts and organic silty clays of low plasticity
	MH	inorganic silts, micaceous or diatomaceous fine sand or silty soils
Sand	SW	well graded sands, gravelly sands, little or no fines
	SP	poorly graded sands, gravelly sands, little or no fines
	SM	silty sands, sand-silt mixtures
	SC	clayey sands, sand-clay mixtures

## **STANDARD OPERATING PROCEDURE**

### **SOP CTO 154-14**

## **CALIBRATION AND CARE OF WATER QUALITY METER**

### **1.0 PURPOSE**

The purpose of this Standard Operating Procedure (SOP) is to establish the procedures for the calibration of the Water Quality Meter used to measure groundwater (purge and development) and surface water field parameters and for the documentation of that calibration and maintenance.

The Naval Training Center (NTC) Great Lakes Environmental Protection Department must approve any deviations from this procedure.

### **2.0 FIELD FORMS AND EQUIPMENT LIST**

The following log books, forms, equipment and supplies are required.

**Site Log Book**

**Equipment Calibration Log Sheet**

**YSI Model 610-D and Sonde, multi parameter, water quality meter with flow through cell**

**Equipment manual**

**Calibration kit**

**Deionized water, paper towels, spray bottle etc.**

### **3.0 PROCEDURES**

This section describes the calibration procedure for the YSI Model 610-D and Sonde (YSI) the meter is supplied with an instruction manual. Sections of this manual are reproduced in this SOP the manual will be on-site and used as the calibration guidance document for the meter's calibration (page 29 section 2.6 starts the calibration procedure). This procedure will list requirements for frequency of calibration and checks to be performed on the meter.

The YSI Model 610-D and Sonde is a multi parameter, water quality meter that may be used to measure open water bodies (streams, ponds, springs etc.) with the probe guard installed. And, with the flow

through cell attached gives the meter the ability to measure groundwater directly from the well, via the pump discharge line prior to coming in contact with the atmosphere. The parameters measured by the YSI for this field effort is:

- Dissolved Oxygen
- Specific Conductance
- Temperature
- pH
- ORP
- Turbidity

### **3.1 DOCUMENTATION**

Follow the procedure in SOP 10 for documentation of calibration an example of this form can be found in Appendix A.

### **3.2 CALIBRATION**

All of the above parameters must be calibrated prior to the start of each field effort. After this initial calibration the YSI will be checked each day that it is used. If the check shows any out-of-spec readings, the parameters will be calibrated. Meter specifications can be found in the equipment manual, starting on page 248. Calibrations and checks as will be documented in the site logbook and on the equipment calibration form, an example of this form can be found in Attachment A. The name, lot number, and expiration date for all calibration, buffers and standards used will be recorded on the equipment calibration form. The meter's model, serial number and name of rental company will also be recorded on the equipment calibration form.

### **3.3 TIPS FOR GOOD CALIBRATION**

- The DO calibration is a water-saturated air calibration. Make certain to loosen the calibration cup seal to allow pressure to equilibrate before calibrating.
- Make certain that sensors are completely submersed in solution and readings are stable when calibration values are entered.
- Use a small amount of calibration solution (previously used solution may be used, then discarded for this purpose) to pre-rinse the sonde.
- Fill a bucket with ambient temperature water to rinse the sonde between calibration solutions.

- Make sure to rinse and dry the probe between calibration solutions. This will reduce carry-over contamination and increase the accuracy of the calibration.

#### **4.0 MAINTENANCE**

The YSI will be rented for the duration of the brief field effort. Therefore, little field maintenance will be required. For any maintenance other than the routine, cleaning, calibrating or battery charging the YSI should be returned to the vender and a replacement sent to the job site.

#### **4.1 METER STORAGE**

For this field effort, the meter storage will be short term, i.e. over-night or between work shifts (4-day break). During these breaks the meter shall be placed on charge. And one half inch of tap or distilled water shall be placed in the meters calibration cup and the cup threaded onto the sonde. The key for short-term storage of probes is to use a minimal amount of water so that the calibration cup will remain at 100% humidity. The water level has to be low enough so that none of the probes are actually immersed. Proper storage of the sonde between usage will extend its life and, will also insure that the unit is ready for use as quickly as possible in the next application.

##### Multi parameter short term storage key points:

- Use enough water to provide humidity, but not enough to cover the probe surfaces.
- Make sure the storage vessel is sealed to minimize evaporation.
- Check periodically to make certain that water is still present.

#### **4.2 PROBE CLEANING**

Rinse probe thoroughly with potable water.

Wash in a mild solution of Liquinox and water wiping with paper towels and/or cotton swabs.

Rinse and soak in deionized water.

If stronger cleaning is required consult section 2.10 page 89 of the equipment manual.

**Note:** Reagents that are used to calibrate and check the YSI may be hazardous. Review Health and Safety Plan, Appendix A of the equipment manual and MSDS's, all of which are on file in the field trailer.

## **STANDARD OPERATING PROCEDURE SOP CTO 154-15**

### **HYDRAULIC CONDUCTIVITY TESTING**

#### **1.0 PURPOSE**

This Standard Operating Procedure (SOP) provides technical guidance for the performance and evaluation of an in-situ hydraulic conductivity testing (slug testing) in monitoring wells at Site 7 – RTC Silk Screening Shop, at the NTC Great Lakes facility.

#### **2.0 REQUIRED FIELD FORMS AND EQUIPMENT**

##### **Solid Slug**

**Pressure transducers and data recorder, including instruction manual**

**Manual water level indicator**

**Hydraulic Conductivity Testing Data Sheet**

**Watch**

**Decontamination equipment and supplies**

**Field Log Book**

**Measuring tape**

#### **3.0 PROCEDURES**

Slug tests are short-term tests designed to provide approximate hydraulic conductivity values for the portion of a formation immediately surrounding the screened/open interval of a well or boring. These tests are much less accurate than pumping tests, as a much more localized area is involved. Therefore, a number of slug tests are typically performed and averaged to determine a representative hydraulic conductivity value for the formation tested. Performance of slug tests may be preferable to pumping tests in situations where handling of large volumes of contaminated water is a concern or when time/budget constraints preclude the more expensive and time-consuming setup and performance of a pumping test.

The procedure is summarized below:

- 3.1 Determine the total depth of the well using a weighted tape or other measuring device. A pressure transducer attached to a data logger shall be placed in the well approximately one foot from the bottom of the well. The transducer will be positioned so that it is about 5 to 10 feet lower than the slug.
- 3.2 Record the well number, the transducer probe identification number being used, the PSI rating for each probe, the depth below top of casing where each probe is positioned, the static water level in the well, and any other information relative to the setup and performance of the slug test. Data and information should be recorded in a bound field notebook and on the Pumping Test Data Sheet.
- 3.3 A falling-head test can be performed where the slug is lowered into the well and the rate of water-level fall with respect to time is recorded until equilibrium is reached. A rising-head test can be performed where a slug is lowered into the well and the water is allowed to equilibrate, then the slug is removed and the rate of water-level rise is measured with respect to time. Falling head slug tests should only be performed in wells with fully submerged screens, while rising head slug tests can be performed in wells with either partially or fully submerged screens/open intervals.
- 3.4 Remove or insert the slug and immediately start the data logger. Record the starting time for the data logger on the form sheet.
- 3.5 Manually measure the depth to water with a water depth indicator to estimate the rate of recovery while the data logger is in the sleep mode. Enter the reading onto the form sheet, along with the corresponding transducer reading from the same time.
- 3.6 Observe the water-level readings once the data logger can be read. Record the times and the readings on the form sheet.
- 3.7 Rate of recovery measurements shall be obtained from time zero (maximum change in water level) until water level recovery exceeds 90 percent of the initial change in water level. In low permeability formations, the test may be cut-off short of 90 percent recovery due to time constraints. Time intervals between water level readings will vary according to the rate of recovery of the well. For a moderately fast recovering well, water level readings at 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.75, 1.0, 1.25, 1.5, 2.0, 2.5, 3.0, 4.0, . . . minutes may be required. With practice, readings at down to 0.05-minute (3 seconds) time intervals can be obtained with reasonable

accuracy, using a pressure transducer and hand held readout. For wells which recover very fast, the pressure transducer and data logger can be set on a logarithmic recording interval. Time intervals between measurements can be extended for slow recovering wells. A typical schedule for measurements for a slow recovering well would be 0, 0.25, 0.5, 0.75, 1.0, 1.5, 2.0, 3.0, 4.0, 6.0, 8.0, 10.0, 15.0, 20.0, 30.0, . . . minutes from the beginning the test. Measurements shall be taken from the top of the well casing.

- 3.8 Stop the test once equilibrium is reached and repeat as necessary to ensure reproducibility.
- 3.9 Remove the pressure transducer, the slug, and the cables from the well and thoroughly decontaminate, per SOP CTO 154-8.
- 3.10 Check all field notes, copy, and place into one file for each test. Download the data recorder as soon as possible and check data. Make an electronic file and paper file of all data and place with the file for evaluation later. Confirm that the data is usable for the intended analysis prior to leaving the field. Time/recovery should be field-plotted on semilog graph paper to determine the data quality. The data set should plot along a sloped, straight line. If excessive data scatter is observed, the test should be rerun until acceptable results are obtained.

#### **4.0 PERSONNEL**

A qualified geologist or hydrogeologist, having experience with these test procedures and equipment, will be needed for each sampling team to carry out the Hydraulic Conductivity tests.

#### **5.0 ATTACHMENTS**

- 1. Hydraulic Conductivity Testing Data Sheet



# HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

Tetra Tech NUS, Inc.

ACAD:FORM\_HYDCONTST.dwg 07/06/99 INL

PROJECT NAME: ..... WELL/BORING NO.: .....  
 PROJECT NO.: ..... GEOLOGIST: .....  
 WELL DIAMETER: ..... SCREEN LENGTH/DEPTH: ..... TEST NO.: .....  
 STATIC WATER LEVEL (Depth/Elevation): ..... DATE: .....  
 TEST TYPE (Rising/Falling/Constant Head): ..... CHECKED: .....  
 METHOD OF INDUCING WATER LEVEL CHANGE: ..... PAGE ..... OF .....  
 REFERENCE PT. FOR WL MEAS. (Top of Casing, Transducer, etc.): .....

ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD ( $\Delta H$ ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD ( $\Delta H$ ) (feet)	WELL SCHEMATIC

	REMARKS:
	CALCS, SKETCH MAPS, ETC.:



## **APPENDIX C**

### **FIELD AUDIT CHECKLIST**



**TETRA TECH, INC.  
FIELD AUDIT CHECKLIST**

Project Name: \_\_\_\_\_ Project No.: \_\_\_\_\_  
 Field Location: \_\_\_\_\_ Completed by: \_\_\_\_\_  
 Project Manager: \_\_\_\_\_ Site Safety Coordinator: \_\_\_\_\_

General Items		In Compliance?		
		Yes	No	NA
<b>Health and Safety Plan Requirements</b>				
1	Approved health and safety plan (HASP) on site or available			
2	Names of on-site personnel recorded in field logbook			
3	HASP compliance agreement form signed by all on-site personnel			
4	Materials Safety Data Sheets on site or available			
5	Designated site safety coordinator present			
6	Daily tailgate safety meetings conducted and documented			
7	On-site personnel meet HASP requirements for medical examinations, fit testing, and training (including subcontractors)			
8	Compliance with specified safe work practices			
9	Documentation of training, medical examinations, and fit tests available from employer			
10	Exclusion, decontamination, and support zones delineated and enforced			
11	Windsock or ribbons in place to indicate wind direction			
12	Illness and injury prevention program reports completed (California only)			
<b>Emergency Planning</b>				
13	Emergency telephone numbers posted			
14	Emergency route to hospital posted			
15	Local emergency providers notified of site activities			
16	Adequate safety equipment inventory available			
17	First aid provider and supplies available			
18	Eyewash stations in place			
<b>Air Monitoring</b>				
19	Monitoring equipment specified in HASP available and in working order			
20	Monitoring equipment calibrated and calibration records available			
21	Personnel know how to operate monitoring equipment and equipment manuals available on site			
22	Environmental and personnel monitoring performed as specified in HASP			

## **APPENDIX VI**

### **DATA MANAGEMENT PLAN**

## **APPENDIX VI**

### **DATA MANAGEMENT PLAN**

#### **1.0 PROJECT PLANNING**

A large amount of environmental and physical data will be collected in support of the Installation Restoration (IR) program. TtNUS has the responsibility of managing this data in a basewide relational database and geographical information system GIS. The contents of the database will be outlined in the Sitewide Data Catalog (that contains the data fields identified in Attachment F1 of this appendix). The Data Catalog will outline what data is contained within the database (by investigation, media, etc.), the generator of the data (TtNUS), and the level of quality of the data where applicable. It should be noted whether or not the analytical data were validated and to what level. It is the responsibility of the TtNUS data manager to coordinate with the NTC Great Lakes project team in order to keep the Data Catalog current and make available the most recent version to the team members. A copy of the Data Catalog will be maintained in the project central file at the office of TtNUS. It is the responsibility of the team members to make certain that the Data Catalog is correct and current and will notify the TtNUS data manager of newly generated data that will support the needs of the project.

Prior to every data collection event, the TOM will call a kick-off meeting to outline the data needs of the task order and to review the data flow process (Attachment F2). Attendees of the kick-off meeting should include the TOM, the Human Health Risk Assessment (HHRA) lead, the Ecological Risk Assessment (ERA) Lead, the Field Operations Leader (FOL), the project chemist, the data management lead and the Geographic Information System (GIS) lead. The data management lead will distribute a copy of the database checklist (Attachment F3) and will lead the project team through its contents. The database checklist will allow the project team to determine how the data will be managed and manipulated in order to achieve the project needs and objectives. A completed copy of the database checklist will be maintained in the project central file and distributed to the members of the project team.

#### **2.0 NEWLY GENERATED DATA**

Upon directive from SOUTHDIV to collect additional site data, the TOM will coordinate with the designated data management lead and GIS lead for the project. It is the responsibility of the FOL to comply with the sample and location nomenclature outlined in the QAPP. It is also the responsibility of the FOL to coordinate with the GIS lead to make certain that the survey technical specifications require the proper coordinate system, which is Illinois State Planar - North American Datum 1983 for the horizontal coordinates and National Geodetic Vertical Datum 1988 for the vertical coordinates.

Prior to field mobilization, the FOL will coordinate with the Sample Management Coordinator (SMC) to initiate a sample tracking process. It is the responsibility of the TOM to make sure that a sampling tracking procedure is implemented. Sample Tracking Request Forms, a sample tracking database example, and example jar labels are included as Attachments F4, F5 and F6, respectively. In the event that a field change has taken place, the FOL is required to complete the Field Task Modification Request (FTMR) that will be forwarded to the members of the project team.

According to the laboratory technical specifications for NTC Great Lakes, the analytical laboratories will be contractually required to deliver the analytical data in NTC Great Lakes standard Electronic Data Deliverable (EDD) format (Attachment F7). Particular attention should be paid to the EDD requirements for validated vs. non-validated data. Once the samples and analyses have been accounted for, the SMC will forward the analytical data to TtNUS for incorporation into the NTC Great Lakes database that is located on the Local Area Network (LAN) in Pittsburgh, PA. The NTC Great Lakes database structure is presented in Attachment F8.

### **3.0 HISTORICAL DATA**

In the event that the NTC Great Lakes project team decides that existing hardcopy data not outlined in the Data Catalog (Attachment F1) needs to be incorporated into the project database; SOUTHDIV shall provide directive to the appropriate consultant to incorporate the data into the project database. The data management lead will review the hardcopy data and prepare a summary of the samples and analyses that need to be entered. The format of the summary table should be similar to the sample tracking database provided in Attachment F5. It is the responsibility of the TOM to review the sample summary table and verify that the entry of this data will satisfy the project requirements. The data management lead will physically edit the hardcopy analytical data to clearly designate which information on the hardcopy needs to be entered into the database. Copies of the marked-up data must be distributed to two separate parties for entry into an Excel spreadsheet. Upon completion of the dual-key entry, the data management lead will electronically compare the two data files to identify discrepancies and correct the data appropriately. The database should then be queried against the sample summary table to make sure that the pertinent data has been entered and checked for accuracy.

The data management lead will coordinate with the GIS lead to acquire the sample location data (Attachment F9) for those samples that need to be entered. Sample location maps should be used to digitize the sample locations using the base mapping layer in the GIS. To the extent possible, the GIS lead will capture, as metadata, the accuracy of the sample location maps used to digitize the location

coordinates. If no sample location maps or other positional information exist for the historical data, the project team should evaluate the utility of this data in the NTC Great Lakes database.

#### **4.0 MAPPING AND GRAPHICS**

CADD mapping is generally provided by the activity. We currently do not use metadata to track changes to the mapping. In addition, Tri-Service Spatial Data Standards (TSSDS) are not utilized unless the mapping from the base already incorporates them. TSSDS is not used in the final GIS, based on the view that limited utility is gained from the substantial time required to incorporate the standards.

In addition to CADD mapping, Digital Ortho Quarter (DOQ) Quads, Aerial Photography, and USGS 7.5 minute Quads are obtained. The Quads are obtained from either the USGS or other suppliers, while the aerial photography is provided by the activity. As necessary, the images are warped to the predetermined coordinate system using Microstation. Again, metadata are not used to track the changes. From survey data, sampling locations are organized, and then a sample-vs-location table is built so that the data can be loaded into the sample\_data.dbf table (Attachment F8).

#### **5.0 THE ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEM (EGIS)**

Environmental data collected in support of the NTC Great Lakes project will be incorporated into the GIS. The themes, layers, and database information contained in the GIS is outlined in the Data Catalog (Attachment F1). The NTC Great Lakes GIS will be made available to the members of the project team. CD-ROM EGIS deliverables will be made available upon request from SOUTHDIV.

#### **6.0 ASSIMILATION OF DATA FROM OUTSIDE SOURCES**

When environmental data is collected by a contractor other than TtNUS, it is the responsibility of the SOUTHDIV Remedial Project Manager (RPM) to notify the TtNUS TOM. The RPM should forward a scope of work directing TtNUS to coordinate with the contractor and incorporate their data into the basewide GIS. To the extent possible, the RPM should direct the Navy Contractor to supply the data to TtNUS in the format outlined in Attachment F8. Once TtNUS has incorporated the data into the GIS, a hardcopy report will be sent to the contractor for verification that pertinent data have been incorporated in a complete and accurate fashion.

## **7.0 SOFTWARE**

TtNUS will standardize on the following software packages when managing and manipulating data for the NTC Great Lakes project:

- Data Management - Microsoft Visual FoxPro 6.0
- GIS - ArcView 3.1 (see Attachment F9 for instructions)
- Geostatistics (2-D Kriging) - Geosoft 3.1b
- 3-D Visualization - EVS Pro 3.0
- Ground Water Modeling - GMS
- Statistical Analysis - Statistica 5.1
- Terrain Analysis - TerraModel 9.4.1

## **8.0 STORAGE OF DATA**

TtNUS utilizes Microsoft NT for Networks as its Information Management System (IMS). The NT IMS has a storage capacity of 6 Gigabytes and currently serves over 110 desktop computers. The NT IMS automatically backs-up the system on a daily basis, thereby disallowing more than one day of work being lost should the network crash or malfunction. The database management and GIS groups have been allocated distinct drives on the Local Area Network (LAN). Environmental data for the NTC Great Lakes Project will be stored in the \\nusrpitbdc1\sddiv\NTC\_Great\_Lakes subdirectory of this drive on the NT Server. Tables, queries, programs, and reports will be saved in the NTC\_Great\_Lakes.pjx file in Microsoft Visual FoxPro. The NTC Great Lakes EGIS will be stored in the \\nusrpitbdc1\gis\NTC\_Great\_Lakes directory on the NT Server. ArcView project files (\*.apr) will be documented in a text file called readme\_project.txt. This text file will also be stored in the \\nusrpitbdc1\gis\NTC\_Great\_Lakes directory.

## **ATTACHMENT F1**

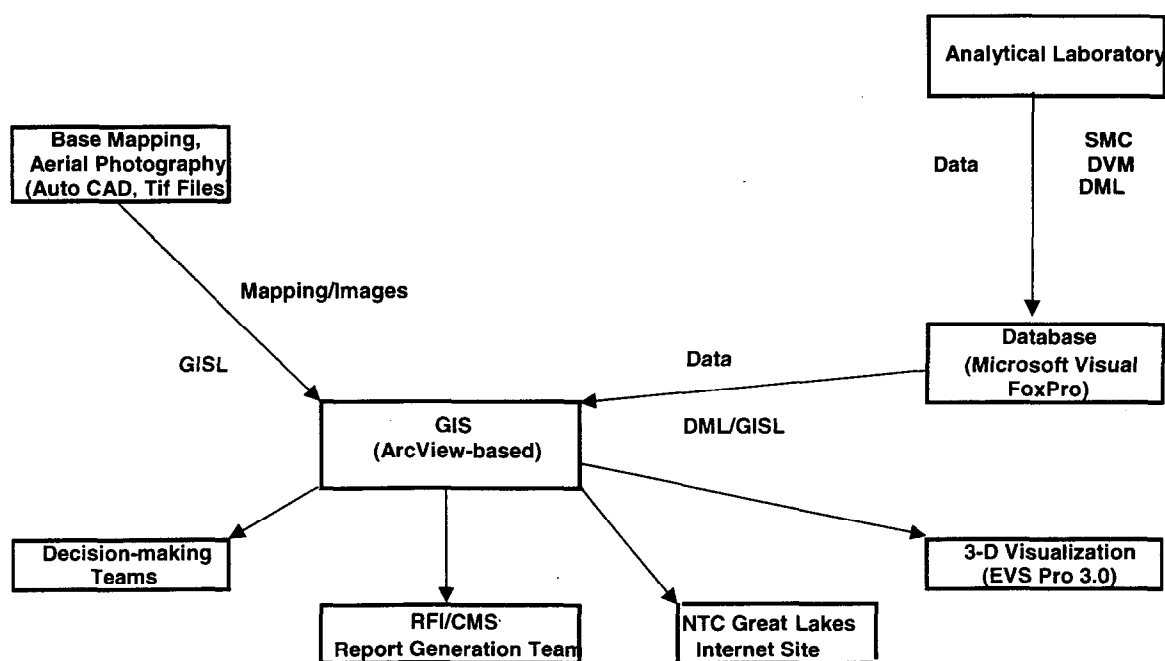
### **DATA CATALOG (Minimum Requirements)**



Category	RFI Phase	Medium Sampled	Sample Type	No. of Samples	Fraction Analyzed

## **ATTACHMENT F2**

### **THE DATA FLOW PROCESS**



**Notes:**

SMC = Sample Management Coordinator  
 DVM = Data Validation Manager  
 DML = Data Management Leader  
 GISL = GIS Leader

**ATTACHMENT F3**

**DATABASE CHECKLIST**

## DATABASE PLANNING CHECKLIST

PROJECT NAME NTC GREAT LAKES

PROJECT NUMBER CTO 0154

PROJECT MANAGER ROBERT DAVIS

PLANNING DATE \_\_\_\_\_

1. Provide a general description of the project (regulatory authority, media to be sampled, approximate number of samples by media, analyses by media, data evaluation tasks required):

---

---

---

---

2. Provide a general description of the sample nomenclature that will be used for samples collected by Tetra Tech NUS:

---

---

---

3. Will historical data be entered in the database? Yes No

4. Will historical data be used to define the nature and extent of contamination?  
Yes No

5. Will historical data be used for risk assessment purposes?  
Yes No

6. How much historical data exists (i.e., number of samples by matrix, analysis by matrix)?

---

---

---

7. In what format will the historical data be provided? Hardcopy Electronic

8. If historical data are in electronic form, what software was used and what is the format?

9. If historical data are in hardcopy form, will Form I's, summary tables, or reports be provided?  
Copies of historical data will be necessary to generate a budget estimate.

---

---

---

10. Will Quality Assurance review of historical data be necessary? Yes No

11. If Quality Assurance review of historical data is necessary, describe the scope of the Quality Assurance review:

---

---

---

---

12. Will a GIS database be necessary for the project? Yes No  
If so, the GIS Group should be consulted for a budget estimate.

13. What nomenclature has been (will be) used to identify field duplicate samples?

---

---

---

---

14. Will field duplicate results be averaged and presented as one result in the database? Will they be presented as distinct results, or will both the average and the distinct results be presented?

---

---

---

---

15. How will the average value for duplicate samples be determined on a matrix-specific basis?

---

---

---

---

16. Are unvalidated data to be included in the database? Yes No

17. Will unvalidated data be used for defining the nature and extent of contamination? Yes No

18. Will unvalidated data be used for risk assessment purposes? Yes No

19. Are field screening (e.g., no-fixed base laboratory) data to be included in the database? Yes No

20. Will field screening data be used for defining the nature and extent of contamination? Yes No

21. Will field screening data be used for risk assessment purposes? Yes No

22. Will statistical correlation of laboratory and field screening data be necessary? Yes No

23. If a correlation exists between field screening and laboratory data, will the results of regression analysis be used to define nature and extent? Yes No

24. If a correlation exists between field screening and laboratory data, will the results of regression analysis be used to support the risk assessment? Yes No

- |     |   |        |
|-----|---|--------|
| 25. | Will fixed base laboratory field parameters be included in the database (e.g., pH, conductance, temperature)? | Yes No |
| 26. | Will statistical correlations be necessary for TCLP versus total analysis data?                               | Yes No |
| 27. | Will statistical correlations be necessary for filtered versus unfiltered samples?                            | Yes No |
| 28. | Will other statistical correlations be necessary?   | Yes No |
| 29. | Are there wells that have been screened in different aquifers?  | Yes No |
| 30. | Will data for various aquifers be segregated by depth?  | Yes No |
| 31. | Can the sample nomenclature system be used to identify wells in different aquifers?                           | Yes No |
| 32. | Will samples from other matrices (soil, sediment, or surface water) be segregated by depth?                   | Yes No |
| 33. | Can the sample nomenclature system be used to identify depth-specificity?                                     | Yes No |
| 34. | Have removal actions been performed at the site?  | Yes No |

If removal actions have been performed, plan and cross-sectional views reflecting the extent of the removal action must be provided.

- |     |  |        |
|-----|--|--------|
| 35. | Will composite sample results be included in the database?   | Yes No |
| 36. | If composite samples are included, how will they be used for the nature and extent of contamination? |        |

- 
- 
- 
- |     |   |  |
|-----|---|--|
| 37. | If composite samples are included, how will they be used for the risk assessment? |  |
|-----|---|--|

- 
- 
- 
- |     |   |        |
|-----|---|--------|
| 38. | Will the site be segregated into Areas of Concern, Solid Waste Management Units, etc? | Yes No |
| 39. | Is the sample nomenclature adequate for such segregation?                             | Yes No |

If the sample nomenclature is inadequate for assigning samples to an AOC or SWMU, the Project Manager or designee must provide a base map of tabular summary clearly delineating the relationship between each sample and each AOC/SWMU.

- |     |  |        |
|-----|--|--------|
| 40. | Were temporal samples collected (e.g., quarterly sampling of wells)? | Yes No |
|-----|--|--------|

41. If temporal samples were collected, how will they be used to define the nature and extent of contamination?

---

---

---

42. If temporal samples were collected, how will they be used to support the risk assessment?

---

---

---

43. Are State, Federal, or Regional criteria to be included in data summary tables? Yes No

44. Identify the criteria that must be presented in the summary tables.

---

---

---

45. Will State, Federal, or Regional criteria be used to select COPCs? Yes No

46. Identify the criteria to be used as COPC selection tools.

---

---

---

47. Are filtered and unfiltered surface water samples differentiated? Yes No

48. If such samples are differentiated, how?

---

---

---

49. Which of these samples will be used for the human health risk assessment?

Surface Water

Filtered Unfiltered

Groundwater

Filtered Unfiltered

50. Which of these samples will be used for the ecological assessment?

Surface Water

Filtered Unfiltered

Groundwater

Filtered Unfiltered

51. Will background data be included in the database?

Yes No

52. How are background samples identified?

---

---

---

53. Will background results be used to support selection of COPCs?

Yes No



53. What statistical analyses will be required for the background data?

---

---

---

54. Will background data be segregated by depth? Yes No

55. What background matrices must be segregated by depth?

---

---

---

56. What format will be used for data presentation (e.g., appendices and summary tables, comprehensive text tables, tag maps, isoconcentration contours, etc.)?

---

---

---

## **ATTACHMENT F4**

### **SAMPLE TRACKING REQUEST FORM**

## **SAMPLE TRACKING AND DATA MANAGEMENT AT PROJECT INCEPTION**

### **PROJECT START-UP CHECKLIST**

ATTACHED IS A PROJECT START-UP CHECKLIST (CAN BE FOUND IN DATA MANAGEMENT CENTRAL FILE). WHENEVER A NEW PROJECT IS STARTED THE TOP PART SHOULD BE FILLED IN. A COPY SHOULD BE RETURNED TO THE DATA MANAGEMENT CENTRAL FILE, KEEP ORIGINAL FOR YOUR RECORDS TO KEEP TRACK OF WHAT HAS BEEN PROVIDED. IMSG WILL CHECK OFF WHEN INFORMATION IS RECEIVED

FOLLOWING THIS PROCESS WILL IMPROVE THE FOLLOWING:

- TURN-AROUND TIME FOR DELIVERABLES NEEDED WHEN RESULTS HAVE BEEN RECEIVED.
- CONFIDENCE THAT THE SAMPLE RESULTS HAVE BEEN RECEIVED
- CONSISTENCY OF SAMPLE NOMENCLATURE
- CORRECTNESS OF SAMPLE ATTRIBUTES
- REVIEW OF INVOICES
- ENABLE IMSG PERSONNEL TO BETTER TRACK UPCOMING WORKLOAD

## PROJECT START-UP CHECKLIST

### INFORMATION NEEDED TO CREATE NEW DATABASE

PROJECT NAME: NTC GREAT LAKES

CTO #: 0154 JOB #: 3939 ETS Code: \_\_\_\_\_

PROJECT MANAGER/CONTACT: ROBERT DAVIS

LABELS: Y / N DUE DATE: \_\_\_\_\_

VALIDATE: Y / N / L DUE DATE: \_\_\_\_\_

COMBINE WITH HISTORICAL DATA: Y/N

### SAMPLE DATA CHECKLIST:

- \_\_\_\_\_ SAMPLE NUMBERS AND ANALYSES (LOCATIONS, DEPTHS)
- \_\_\_\_\_ SECTION OF WORK PLAN PERTAINING TO SAMPLE NOMENCLATURE
- \_\_\_\_\_ LABORATORY/BOTTLE REQUIREMENTS
- \_\_\_\_\_ LAB SPECS
- \_\_\_\_\_ COC'S
- \_\_\_\_\_ SAMPLE LOG SHEETS
- \_\_\_\_\_ DUPLICATE ID'S / ORIGINALS
- \_\_\_\_\_ SURVEY DATA / SAMPLE LOCATION MAPS
- \_\_\_\_\_ BREAKDOWN OF PROJECT BY SITE / MATRIX FOR FUTURE PRINTOUTS
- \_\_\_\_\_ TABLE HEADERS (SEE EXAMPLE)

### TO BE COMPLETED BY MSG:

- \_\_\_\_\_ FINAL RESULTS GIVEN TO \_\_\_\_\_ (PM/MSG)  
DATE: \_\_\_\_\_
- \_\_\_\_\_ SAMPLE DATA LOADED INTO NEW/EXISTING PROJECT DATABASE
- \_\_\_\_\_ RESULTS LOADED INTO NEW/EXISTING PROJECT DATABASE  
PATHNAME OF PROJECT DATABASE: \_\_\_\_\_
- \_\_\_\_\_ DATA LOADED INTO GIS

## **ATTACHMENT F5**


### **SAMPLE TRACKING DATABASE EXAMPLE**


**CTO 0154 SDG F5717**


Sdg	Sample Number	Lab id	Fraction	Sort	Lab Rec	Rec Date	Turn-time	Laboratory
F5717	07SB09-0506	F5717-2	M	M	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	MISC	CL	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	MISC	NTA	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	MISC	NTI	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	MISC	SO4	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	MISC	SUL	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	OS	OS	03-Feb-00	28-Feb-00	25	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	OV	ETHA	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	OV	ETHE	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	OV	METH	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	OV	OV	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ
F5717	07SB09-0506	F5717-2	PAH	PAH	25-Jan-00	28-Feb-00	34	ACCUTEST, NJ


## **ATTACHMENT F6**


### **EXAMPLE SAMPLE JAR LABELS**


 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> CTO 038 <b>Location:</b> NTC GL
Sample No: BGSBP0401		Tag #: A0001
Date: (1)	Time: (2)	Preserve:
Analysis: TAL Metals + Tin		Matrix: SOIL
Sampled By: (3)		Laboratory:


 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> <b>Location:</b>
Sample No:		Tag #:
Date: (1)	Time: (2)	Preserve:
Analysis:		Matrix:
Sampled By:		Laboratory:


 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> CTO 038 <b>Location:</b> NTC GL
Sample No: BGSBP0401		Tag #: A0001
Date: (1)	Time: (2)	Preserve:
Analysis: TAL Metals + Tin		Matrix: SOIL
Sampled By: (3)		Laboratory:

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> <b>Location:</b>
Sample No:		Tag #:
Date: (1)	Time: (2)	Preserve:
Analysis:		Matrix:
Sampled By:		Laboratory:

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> CTO 038 <b>Location:</b> NTC GL
Sample No: BGSBP0401		Tag #: A0001
Date: (1)	Time: (2)	Preserve:
Analysis: TAL Metals + Tin		Matrix: SOIL
Sampled By: (3)		Laboratory:

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> <b>Location:</b>
Sample No:		Tag #:
Date: (1)	Time: (2)	Preserve:
Analysis:		Matrix:
Sampled By:		Laboratory:

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> <b>Location:</b>
Sample No:		Tag #:
Date: (1)	Time: (2)	Preserve:
Analysis:		Matrix:
Sampled By: (3)		Laboratory:

 Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090		<b>Project:</b> <b>Location:</b>
Sample No:		Tag #:
Date: (1)	Time: (2)	Preserve:
Analysis:		Matrix:
Sampled By: (3)		Laboratory:



## **ATTACHMENT F7**

### **ELECTRONIC DATA DELIVERABLE REQUIREMENTS FOR ANALYTICAL LABORATORIES**

## ELECTRONIC DATA FORMAT REQUIREMENTS

### 1.0 INTRODUCTION

The laboratory is to provide 3.5" high density diskette(s) or compact disks (CDs) containing separate database (DBF) and portable document format (PDF) files in the format specified in this Attachment. The electronic deliverable includes the environmental samples, sample dilutions, sample reanalyses, and laboratory quality control samples. **Entries in the electronic deliverable must agree exactly with the final entries reported on the hardcopy data package sample result summaries.** Corrections made to the hardcopy data must also be made to the electronic file. Appropriate qualifiers as identified by the analytical protocol must also be designated; laboratory QC non-compliance codes are not to be depicted.

Each diskette or CD is to be properly labeled with the laboratory name, project name, file name(s), and laboratory point of contact. Electronic files should be delivered in the same fashion as are the hard copy data packages. A separate .dbf file will be made for each analytical fraction (by method) and each sample delivery group (SDG). The files will be named with the first character being the analytical fraction designator, followed by an underscore, followed by the SDG name. For example, the file for the volatile fraction for SDG BR001 should be named V\_BR001.DBF. The PDF files will follow the same format as the database files. Additionally, the laboratory must provide a hardcopy listing the electronic files saved to the diskette, indicating what analytical fraction and matrix the file data contained therein pertain to. Electronic data deliverables are due within the same time established for the associated hardcopy data packages.

In addition, the laboratory QC officer must read and sign a copy of the Quality Assurance Review Form displayed on the next page of this Attachment. Electronic deliverables are not considered to be complete without the accompanying Quality Assurance Review Form.

I \_\_\_\_\_, as the designated Quality Assurance Officer, hereby attest that the electronic deliverables have been thoroughly reviewed and are in agreement with the associated hardcopy data. The enclosed electronic files have been reviewed for accuracy (including significant figures), completeness and format. The laboratory will be responsible for labor time necessary to correct enclosed electronic deliverables that have been found to be in error. I can be reached at ( ) \_\_\_\_\_ if there are any questions or problems with the enclosed electronic deliverables.

Signature: \_\_\_\_\_ Title: \_\_\_\_\_ Date: \_\_\_\_\_

The analytical data will be delivered electronically in a Dbase III file format (filename.dbf) and PDF format. The exact structure of the database is described in the table below. It will be the responsibility of the laboratory to make sure that the electronic entries are in strict accordance with the information provided on the Form I.

An example database will be sent for review prior to the first electronic deliverable in Dbase III format. The example file will be examined for completeness and comments will be sent to the laboratory. Questions regarding the electronic deliverable will be directed to Andrew Kendrick at Tetra Tech NUS (412) 921-8623.

DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
SAMPLE_NO	C	25	Field sample ID as listed on the chain-of-custody. The sample number indicated in this field should never be truncated. The only exception for this field not matching the chain-of-custody is for reanalyses and matrix spike results in which a RE or MS suffix will be added to the sample number respectively.
TRUNCATE	C	15	If the field sample ID listed on the Chain of Custody is truncated by the laboratory for use with the laboratory software, the truncated sample ID should appear in this field.
LAB_ID	C	15	Laboratory number for the given sample.
LABORATORY	C	25	Laboratory name.
BATCH_NO	C	10	Laboratory code for batch of samples included in a given run.
ASSOC_BLNK	C	15	Laboratory name of the method blank associated with that particular batch of samples.
QC_TYPE	C	15	Normal Environmental Sample = "NORMAL", Laboratory Duplicate = "DUPLICATE", Matrix Spike = "MS", Matrix Spike Duplicate = "MSD", Laboratory Control Sample = "LCS", Laboratory Control Sample Duplicate = "LCSD", Method Blank = "M_BLANK", Preparation Blank = "P_BLANK".
SAMP_DATE	D	8	Date of sample collection as indicated on the Chain of Custody. Example: 11/07/93.
REC_DATE	D	8	Date sample was received by the laboratory.
EXTR_DATE	D	8	Date sample was extracted or prepared by the laboratory.
ANAL_DATE	D	8	Date sample was analyzed by the laboratory.
RUN_NUMBER	N	2 (0)	The number of the analytical run for a given sample in sequence. For example, if a sample is diluted and reanalyzed, the original run number would be 1 and the reanalysis would be 2.
SDG	C	15	Sample delivery group identifier assigned by the laboratory. This number should <u>exactly</u> match the SDG designated on the hardcopy data package.

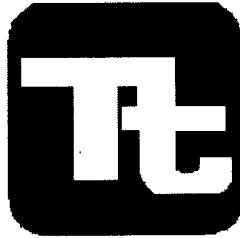
DATA FIELD	DATA TYPE	FIELD WIDTH	DATA FIELD DESCRIPTION
PROJECT_NO	C	10	Identification of Project Number or CLEAN Task Order (CTO) number.
PROJ_MNGR	C	25	The Tetra Tech NUS Project Manager's last name, followed by a comma, followed by the first initial of the Project Manager (e.g. Hutson, D).
PARAMETER	C	45	Chemical or analyte name <u>exactly</u> as reported on Form I.
CAS_NO	C	10	Chemical Abstract Service number for the parameter listed. The CAS number should be reported exactly as it is listed in publications such as the Merck Index. This field should be left blank for those parameters not having CAS numbers (e.g. Total Organic Carbon).
FRACTION	C	5	Metals = 'M', Volatiles = 'OV', Semivolatiles/BNAs = 'OS', Pesticides = 'PEST', Herbicides = 'HERB', Polychlorinated Biphenyls = 'PCB', Explosives = 'EXP', Any petroleum hydrocarbon or fuel = 'TPH', Wet Chemistry = 'WET', Radionuclide = 'RAD', Miscellaneous = 'MISC'
METHOD	C	20	Analytical method used to quantitate parameter concentrations as listed in the laboratory technical specification (e.g. '8270A' for SW-846 Method 8270A).
LAB_RESULT	N	20 (6)	Reported value in units specified in the UNITS field containing the proper number of significant digits. The % Recovery will be placed in this field for matrix spike and laboratory control sample results.
UNITS	C	5	The units of measure as reported on the Form I.
LAB_QUAL	C	2	The laboratory qualifier as reported on the Form I. For example, a 'U' qualifier should be used for nondetected results.
IDL	N	15 (6)	Instrument detection limit in units specified in the UNITS field.
MDL	N	15 (6)	Method detection limit in units specified in the UNITS field and method specified in the METHOD field.
CRDL_CRQL	N	15 (6)	Contract Required Detection/Quantitation Limit in the units specified in the UNITS field. RDL for non-CLP parameters.
DIL_FACTOR	N	6 (1)	Dilution factor.
PCT_MOIST	N	5 (1)	Percent moisture for soil samples; blank for water samples.
COMMENTS	C	20	Analytical result qualifier or comment other than that listed in the LAB_QUAL field. Example: 'Reanalysis'.

C = Character string (everything will be reported in capital letters)  
N = Numeric string (decimal places are in parentheses in field width column)  
D = Date (Ex: 05/25/97)

## **ATTACHMENT F8**

### **DATABASE STRUCTURE**

## **DATA DICTIONARY**



## **TETRA TECH NUS DATABASE STANDARDS**

**January 1999**

**DRAFT**

**TABLE:** well  
**PRIMARY KEY:** location

**Table Structure**

FIELD	DESCRIPTION
location	Unique location name.
post_id	Location name as derived from original source document.
instal_date	Date the monitoring well was installed. Null for other location types.
loc_type	Type of location (e.g., soil boring, GW well, drive point, wipe)
Northing	Northing coordinate in horizontal datum referenced in the HORIZ_DATUM field.
Easting	Easting coordinate in horizontal datum referenced in the HORIZ_DATUM field.
horiz_datum	Datum in which the horizontal coordinates were derived.
grnd_surf	Ground surface elevation with reference to mean sea level in vertical datum referenced in the VERT_DATUM field.
vert_datum	Datum in which the vertical coordinates were derived.
datum_state	State for which datum was developed.
surveyed	Logical field denoting whether positional data were surveyed or digitized.
Surveyor	Company who performed the survey.
survey_date	Date in which survey was performed.
surv_method	Surveying method used.
longitude	Longitude.
latitude	Latitude.

**Table Indexes**

INDEX	TYPE
location	Primary
hd	Regular
vd	Regular
loc_type	Regular

**Table Relations:**

Relation 1

\*RelatedChild loc\_type  
\*RelatedTable loc\_type\_vvl  
\*RelatedTag loc\_type

Relation 2

\*RelatedChild cd  
\*RelatedTable coord\_datum\_vvl  
\*RelatedTag cd

**TABLE:** loc\_type\_vvl - Valid value list for LOC\_TYPE field in the well table.  
**PRIMARY KEY:** loc\_type

**Table Structure**

FIELD	DESCRIPTION
loc_type	Location type
description	Description of location type



**Table Indexes**

INDEX	TYPE
loc_type	Primary

**TABLE:** coord\_datum\_vvl - Valid value list for HORIZ\_DATUM field in the well table.

**PRIMARY KEY:** cd (coord\_datum)

**Table Structure**

FIELD	DESCRIPTION
coord_datum	Datum in which coordinates reflect.

**Table Indexes**

INDEX	TYPE
cd (coord_datum)	Primary

**TABLE:** sample\_data - Sample data table

**PRIMARY KEY:** nsample

**Table Structure**

FIELD	DESCRIPTION
location	Unique location name.
Matrix	Sample matrix.
nsample	Unique sample identification.
sample	Sample identification as designated on Chain-of-Custody.
sacode	Sample code for reference to field duplicates.
top_depth	Depth in feet to the top of the sample interval. Applicable for soil and sediment samples.
Bottom_depth	Depth in feet to the bottom of the sample interval. Applicable for soil and sediment samples. <i>Rule Expression:</i> if(bottom_depth>0,top_depth<=bottom_depth)
qc_type	Quality control type.
status	Status of sample location – Normal or excavated.
sample_date	Date in which sample was collected.
validated	Logical field denoting whether or not data validation was performed on sample.
coll_method	Sample collection method.
cto_proj	Clean task order (Navy) or project number in which the sample was collected (e.g., "129").
proj_manager	Internal project manager for which the data were originally generated (e.g. "Hutson, D.").

**Table Indexes**

INDEX	TYPE
location	Regular
nsample	Primary
sacode	Regular
matrix	Regular
status	Regular

qc_type	Regular
coll_meth	Regular

**Table Relations:**

Relation 1

\*RelatedChild sacode  
\*RelatedTable sacode\_vvl  
\*RelatedTag sacode

Relation 2

\*RelatedChild qc\_type  
\*RelatedTable qc\_type\_vvl  
\*RelatedTag qc\_type

Relation 3

\*RelatedChild matrix  
\*RelatedTable matrix\_vvl  
\*RelatedTag matrix

Relation 4

\*RelatedChild location  
\*RelatedTable well  
\*RelatedTag location

Relation 5

\*RelatedChild coll\_meth  
\*RelatedTable coll\_method\_vvl  
\*RelatedTag coll\_meth

**TABLE:** sacode\_vvl - Sample code valid value list for SACODE field in sample\_data.dbf

**PRIMARY KEY:** sacode

**Table Structure**

FIELD	DESCRIPTION
sacode	Sample code designating whether sample is a normal environmental sample, a field duplicate, or the average of field duplicate pairs.
description	Description of sacode entry.

**Table Indexes**

INDEX	TYPE
sacode	Primary

**TABLE:** qc\_type\_vvl - Quality control valid value list for QC\_TYPE field in sample\_data.dbf

**PRIMARY KEY:** qc\_type

**Table Structure**

FIELD	DESCRIPTION
qc_type	Quality control type.
description	Description of quality control type.

**Table Indexes**

INDEX	TYPE
qc_type	Primary

**TABLE:** matrix\_vvl - Matrix valid value list for MATRIX field in sample\_data.dbf

**PRIMARY KEY:** matrix

**Table Structure**

FIELD	DESCRIPTION
matrix	Sample matrix.
description	Description of sample matrix code.

**Table Indexes**

INDEX	TYPE
matrix	Primary

**TABLE:** well\_completion  
**PRIMARY KEY:** None

**Table Structure**

FIELD	DESCRIPTION
location	Unique location name.
top_casing	Elevation of top of well casing in vertical datum found in VERT_DATUM in the well table.
hole_diameter	Diameter of the drilled hole in inches. <i>Rule</i> hole_diameter>casing_id.AND.hole_diameter>casing_od <i>Expression:</i>
scr_aquifer	Aquifer name in which the screen resides.
screen_material	Type of material from which the screen is constructed.
scrn_slot_size	Screen slot size in thousandths of an inch.
scrn_top_depth	Depth below ground surface to the top of the screen (in feet).
scrn_bot_depth	Depth below ground surface to the bottom of the screen. <i>Rule</i> if(scrn_bot_depth>0,scrn_top_depth<scrn_bot_depth) <i>Expression:</i>
scrn_top_elev	Elevation the top of the screen in vertical datum found in VERT_DATUM in the well table.
scrn_bot_elev	Elevation the top of the screen in vertical datum found in VERT_DATUM in the well table. <i>Rule</i> if(scrn_bot_elev>0,scrn_top_depth>scrn_bot_depth) <i>Expression:</i>
drill_method	Drilling method for well installation.
contractor	Drilling contractor.
casing_material	Type of material in which the casing is constructed from.
depth_to_seal	Depth below ground surface to seal (in feet).
seal_material	Type of material in which the seal is constructed from.
fill_top_depth	Depth below ground surface to the top of fill material (in feet).
fill_bot_depth	Depth below ground surface to the bottom of fill material (in feet). <i>Rule Expression:</i> if(fill_bot_depth>0,fill_top_depth<scrn_bot_depth)
fill_material	Type of material used for fill.
comments	Geologist's comments

Table Indexes

INDEX	TYPE
location	Regular

Table Relations:

Relation 1

\*RelatedChild location  
\*RelatedTable well  
\*RelatedTag location

**TABLE:** lithology

**PRIMARY KEY:** None

FIELD	DESCRIPTION
location	Unique location name.
top_lithology	Depth in feet below ground surface to the top of lithologic unit.
bottom_lithology	Depth in feet below ground surface to the bottom of lithologic unit.
uscs_code	Unified Soil Classification System for lithology type.
blow_counts	Number of blow counts recorded on boring log.
description	Geologist's description of lithology.
comments	Geologist's comments.

**Table Indexes**

INDEX	TYPE
location	Regular
uscs_code	Regular

**Table Relations:**

Relation 1

\*RelatedChild location  
\*RelatedTable well  
\*RelatedTag location

Relation 2

\*RelatedChild uscs\_code  
\*RelatedTable lithology\_vvl  
\*RelatedTag uscs\_code

**TABLE:** lithology\_vvl - Lithology valid value list for USCS\_CODE field in lithology.dbf

**PRIMARY KEY:** uscs\_code

**Table Structure**

FIELD	DESCRIPTION
uscs_code	Unified Soil Classification System for lithology type.
descript	Description of lithology for given USCS code.

**Table Indexes**

INDEX	TYPE
uscs_code	Primary

**TABLE:** coll\_method\_vvl - Collection method valid value list for COLL\_METHOD field in sample\_data.dbf  
**PRIMARY KEY:** coll\_meth

**Table Structure**

FIELD	DESCRIPTION
coll_method	Sample collection method

**Table Indexes**

INDEX	TYPE
coll_method	Primary

**TABLE:** cas\_vvl - CAS number valid value list for CAS field in analytical\_results.dbf  
**PRIMARY KEY:** cas

**Table Structure**

FIELD	DESCRIPTION
parameter	Parameter or chemical name
cas	Chemical Abstracts Service Number

**Table Indexes**

INDEX	TYPE
parameter	Regular
cas	Primary

**TABLE:** analytic\_results

**PRIMARY KEY:** nfp (nsample+fraction+parameter)

**Table Structure**

FIELD	DESCRIPTION
nsample	Unique sample identification.
lab_id	Laboratory sample identification.
laboratory	Laboratory name.
batch_no	Analytical batch number.
assoc_blnk	Associated blank.
extr_date	Extraction date.
anal_date	Analysis date.
run_number	Sequential analytical run number.
sdg	Sample delivery group.
parameter	Parameter or chemical name (using IUPAC nomenclature where appropriate).
cas	Chemical Abstracts Service Number.
fraction	Analytical fraction.
method	Analytical method.
lab_result	Analytical result as reported by the laboratory.
lab_qual	Qualifier as reported by the laboratory.
val_res	Final result (via validation or otherwise).
result	Final analytical result with the correct number of significant figures.
val_qual	Validation qualifier (null if data were not validated).
qual	Final qualifier (validation or otherwise).
qual_code	Validation flag used to define the quality control noncompliance.
units	Units of measure for the RESULT field.
idl	Instrument detection limit (same units as UNITS field).
mdl	Method detection limit (same units as UNITS field).
crdl_crql	Contract required detection/quantitation limit (same units as UNITS field).
dil_factor	Dilution factor.
pct_moist	Percent moisture.
comments	Comments from laboratory analyst.

**Table Indexes**

INDEX	TYPE
nfp	Primary
units	Regular
qual	Regular
fraction	Regular
parameter	Regular
nsample	Regular
cas	Regular

**Table Relations:**

Relation 1

\*RelatedChild cas

\*RelatedTable cas\_vvl

\*RelatedTag cas

Relation 2

\*RelatedChild units  
\*RelatedTable units\_vvl  
\*RelatedTag units

Relation 3

\*RelatedChild qual  
\*RelatedTable qual\_vvl  
\*RelatedTag qual

Relation 4

\*RelatedChild fraction  
\*RelatedTable fraction\_vvl  
\*RelatedTag fraction

Relation 5

\*RelatedChild parameter  
\*RelatedTable para\_vvl  
\*RelatedTag para

Relation 6

\*RelatedChild nsample  
\*RelatedTable sample\_data  
\*RelatedTag nsample

**TABLE:** units\_vvl - Units valid value list for UNITS field in analytical\_results.dbf

**PRIMARY KEY:** Units

**Table Structure**

FIELD	DESCRIPTION
units	Units of measure for chemical analysis
description	Description of units

**Table Indexes**

INDEX	TYPE
units	Primary

**TABLE:** qual\_vvl

**PRIMARY KEY:** qual - Qualifier valid value list for QUAL field in analytic\_results.dbf

**Table Structure**

FIELD	DESCRIPTION
qual	Final QA qualifier
description	Definition of qualifier

**Table Indexes**

INDEX	TYPE
qual	Primary



**TABLE:** fraction\_vvl - Analytical fraction valid value list for FRACTION field in analytic\_results.dbf

**PRIMARY KEY:** fraction

**Table Structure**

FIELD	DESCRIPTION
fraction	Analytical fraction
description	Description of fraction

**Table Indexes**

INDEX	TYPE
fraction	Primary

**TABLE:** para\_vvl

**PRIMARY KEY:** parameter

**Table Structure**

FIELD	DESCRIPTION
para	Parameter or chemical name
frac_name	Analytical fraction for given parameter

**Table Indexes**

INDEX	TYPE
para	Primary

**TABLE:** fluid

**PRIMARY KEY:** None

**Table Structure**

FIELD	DESCRIPTION
location	Unique location name
meas_elev	Measuring point elevation
dep_to_water	Depth below ground surface to water table (in feet)
dep_to_fp	Depth below ground surface to free product (in feet)
elev_water	Elevation of water level
elev_fp	Elevation of free product
prod_thick	Product thickness in feet
meas_date	Date measurement was taken.

**Table Indexes**

INDEX	TYPE
location	Regular

Table Relations:

Relation 1

\*RelatedChild location

\*RelatedTable well

\*RelatedTag location

## **ATTACHMENT F9**

### **ARCVIEW GIS STRUCTURE**

## ARCVIEW GIS STRUCTURE

The project ArcView GIS will have the following directory structure and database table structure.

### PART ONE: DIRECTORY STRUCTURE

The following table defines the directory structure and major file names/types located within each directory.

Main subdirectory	First tier subdirectories	Second tier subdirectories	Files/Types
p:\gis\project name\	database\		coordinate.dbf cross_reference.dbf res_gw.dbf res_so.dbf res_sd.dbf res_sw.dbf well_completion.dbf
		criteria\	crit_gw.dbf crit_so.dbf crit_sd.dbf crit_sw.dbf crit_des.dbf
	mapping\	aerial\	registered aerial photos
		drg\	USGS Digital Raster Graphic
		image\	GeoStatistic Layers, pictures of sites, equipment, EVS, and other raster files.
		dwg\	AutoCAD files
		dgn\	Microstation files
		shp\	samp_gw.shp .dbf .shx samp_so.shp .dbf .shx samp_sd.shp .dbf .shx samp_sw.shp .dbf .shx and other AV shape files
	working\	database\	files used to generate specific drawings will be put under the working subdirectory in subdirectories similar to database & mapping. These will not be included in CD deliverable.
		mapping\	same as above

## PART TWO: DATABASE TABLE STRUCTURE

The project ArcView GIS will contain separate database tables to store analytical, criteria, and coordinate information. The structure of these tables is presented below.

### *Analytical Data Table*

The following table lists the fields contained in the analytic database table.

FIELD	VISIBLE	ALIAS*	DESCRIPTION
Site	Yes	Site or SWMU	Site or SWMU.
Location	Yes	Location	Unique location name.
Nsample	Yes	Sample	Unique sample identification.
Sample	No		Sample identification as designated on Chain-of-Custody.
sample_date	Yes	Sample Date	Date on which sample was collected.
Matrix	Yes	Matrix	Sample matrix.
Sacode	Yes	Sample Code	Sample code for reference to field duplicates.
Depth	Yes	Depth	Depth in feet to the middle of the sample interval. Applicable for soil and sediment samples.
top_depth	Yes	Top Depth	Depth in feet to the top of the sample interval. Applicable for soil and sediment samples.
bottom_depth	Yes	Bottom Depth	Depth in feet to the bottom of the sample interval. Applicable for soil and sediment samples. Rule Expression: if(bottom_depth>0,top_depth<=bottom_depth)
Parameter	Yes	Parameter	Parameter or chemical name (using IUPAC nomenclature where appropriate).
Cas	Yes	CAS	Chemical Abstracts Service Number.
Fraction	Yes	Fraction	Analytical fraction.
val_res	Yes	Numeric Result	Final result (via validation or otherwise).
Qual	Yes	Qualifier	Final qualifier (validation or otherwise).
Units	Yes	Units	Units of measure for the RESULT field.
Method	Yes	Method	Analytical method.
Status	Yes	Status	Status of sample location – Normal or excavated.
Validated	Yes	Validated	Logical field denoting whether or not data validation was performed on sample.
coll_method	Yes	Collection Method	Sample collection method (e.g., grab/composite).
cto_proj	Yes	CTO	Clean task order (Navy) or project number for which the sample was collected (e.g. "129").

FIELD	VISIBLE	ALIAS*	DESCRIPTION
proj_manager	Yes	Project Manager	Internal project manager for which the data was originally generated (e.g. "Kendrick, A.").
lab_id	No	Laboratory ID	Laboratory sample identification.
Laboratory	No	Laboratory	Laboratory name.
batch_no	No	Batch Number	Analytical batch number.
assoc_blnk	No	Associated Blank	Associated blank.
extr_date	No	Extraction Date	Extraction date.
anal_date	No	Analysis date	Analysis date.
run_number	No	Run Number	Sequential analytical run number.
sdg	No	SDG	Sample delivery group.
lab_result	No	Result	Analytical result as reported by the laboratory.
lab_qual	No	Lab Qualifier	Qualifier as reported by the laboratory.
result	No	String Result	Final analytical result with the correct number of significant figures.
val_qual	No	Validation Qualifier	Validation qualifier (null if data were not validated).
idl	No	Detection Limit	Instrument detection limit (same units as UNITS field).
mdl	No	Detection Units	Method detection limit (same units as UNITS field).
crdl_crql	No		Contract required detection/quantitation limit (same units as UNITS field).
dil_factor	No	Dilution factor	Dilution factor.
pct_moist	No	Percent moisture	Percent moisture.
ourresult	No		
qc_type	No		Quality control type.
comments	No	Comments	Comments from laboratory analyst.

\*A blank indicates that no alias exists.

### **Criteria Table**

Each medium will have a criteria table to specify the applicable criteria for the parameters.

FIELD	ALIAS	DESCRIPTION
parameter	Parameter	Parameter or chemical name (using IUPAC nomenclature where appropriate)
epa_mcl	None	Federal MCL – groundwater

Note: usually there will be many criteria fields. This example table only shows the “epa\_mcl” criteria field.

### **Criteria Description Table**

This table stores the definition or description of the standards and criteria used in the project. For example, epa\_mcl's media would be GW, description would be “Federal Maximum Contaminant Level”.

FIELD	Visible	DESCRIPTION
Field	Yes	
Media	Yes	
Descript	Yes	

### **Coordinate Table**

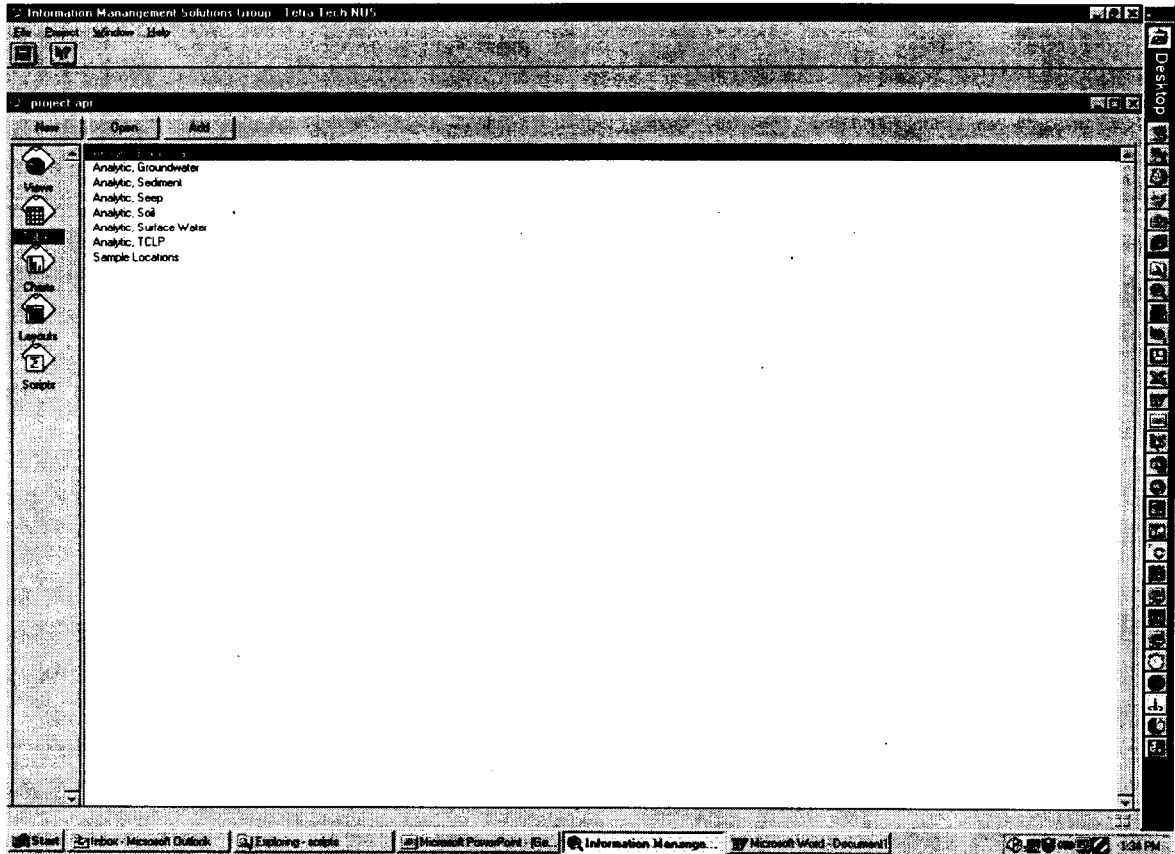
The coordinate table holds the geographic position information of sampling locations

FIELD	Visible	ALIAS*	DESCRIPTION
location	Yes		Unique location name.
post_id	Yes	Location Designation	Location name as derived from original source document.
instal_date	No	Installation Date	Date the monitoring well was installed. Null for other location types.
loc_type	Yes	Location Type	Type of location. Example MW, HP, etc.
northing	Yes		Northing coordinate in horizontal datum referenced in the HORIZ_DATUM field.
easting	Yes		Easting coordinate in horizontal datum referenced in the HORIZ_DATUM field.
grnd_surf	Yes	Ground Surface Elevation	Ground surface elevation with reference to mean sea level in vertical datum referenced in the VERT_DATUM field
horiz_datum	Yes	Horizontal Datum	Datum in which the horizontal coordinates were derived.

FIELD	Visible	ALIAS*	DESCRIPTION
vert_datum	Yes	Vertical Datum	Datum in which the vertical coordinates were derived.
fatum_state	Yes	Coordinate System	State for which datum was developed.
durveyed	Yes		Logical field denoting whether positional data were surveyed or digitized.
durveyor	Yes		Company who performed the survey.
durvey_date	No	Survey Date	Date on which survey was performed.
durv_method	No	Survey Method	Surveying method used.
longitude	No		Longitude.
latitude	No		Latitude.
gw_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
sd_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
so_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
sw_code	Yes		This will be populated by database personnel. It will be used for event driven theme.
_nullflags	No		Various fields are put in by database personnel starting here and followed by several fields. Make these invisible.

\*A blank indicates that no alias exists.

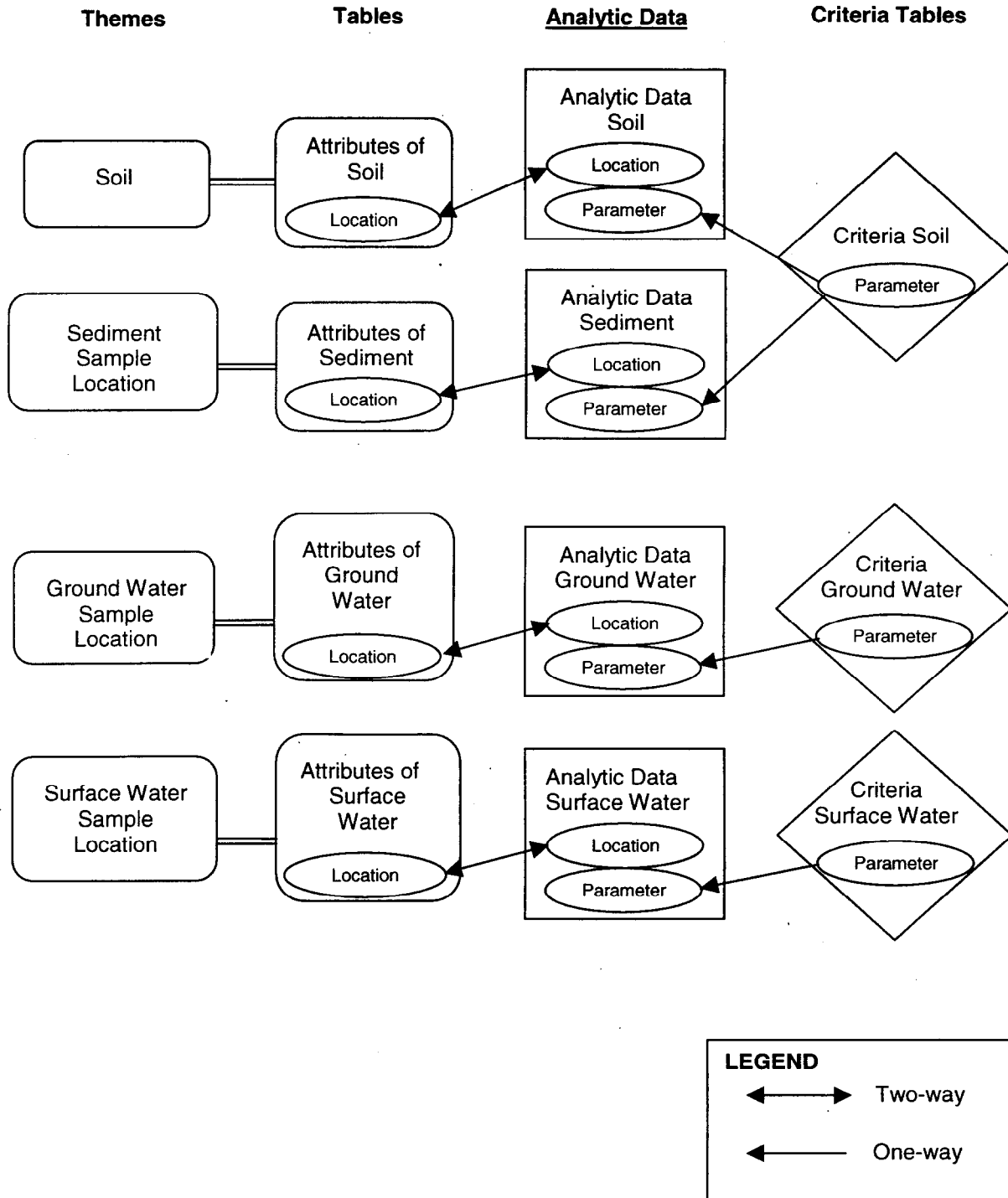
## TABLE LINKS



Sample location theme attribute tables are two-way linked to the corresponding analytical data table. In addition, the analytical data tables are joined to the criteria table. The following diagram illustrates the relationship.



Database Model:



## **APPENDIX VII**

### **HEALTH AND SAFETY PLAN**

**Health and Safety Plan**  
for  
**Remedial Investigation**  
and  
**Risk Assessment**  
at  
**Site 7 RTC Silk Screening Area**  
and  
**Site 17 Pettibone Creek/Boat Basin**

**Naval Training Center**  
**Great Lakes**  
Great Lakes, Illinois



**Southern Division**  
**Naval Facilities Engineering Command**  
Contract No. N62467-94-D-0888  
Contract Task Order 0154

July 2001

**HEALTH AND SAFETY PLAN  
for  
REMEDIAL INVESTIGATION  
and  
RISK ASSESSMENT  
at  
SITE 7 RTC SILK SCREENING AREA  
and  
SITE 17 PETTIBONE CREEK/BOAT BASIN  
NAVAL TRAINING CENTER GREAT LAKES  
GREAT LAKES, ILLINOIS**

**COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT**

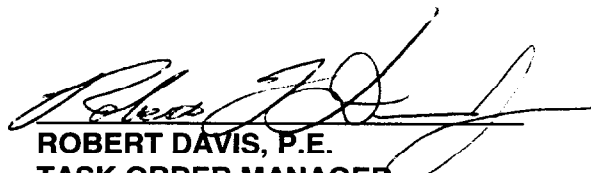
**Submitted to:  
Southern Division  
Naval Facilities Engineering Command  
2155 Eagle Drive  
North Charleston, South Carolina 29406**

**Submitted by:  
Tetra Tech NUS, Inc.  
661 Andersen Drive  
Pittsburgh, Pennsylvania 15220**

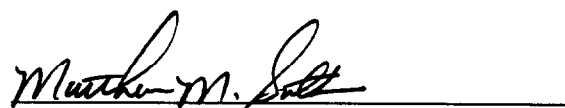
**CONTRACT NUMBER N62467-94-D-0888  
CONTRACT TASK ORDER 0154**

**JULY 2001**

**PREPARED UNDER THE  
SUPERVISION OF:**

  
**ROBERT DAVIS, P.E.  
TASK ORDER MANAGER  
TETRA TECH NUS, INC.  
PITTSBURGH, PENNSYLVANIA**

**APPROVED FOR SUBMITTAL BY:**

  
**MATTHEW M. SOLTIS, CIH, CSP  
CLEAN HEALTH & SAFETY MANAGER  
TETRA TECH NUS, INC.  
PITTSBURGH, PENNSYLVANIA**



TETRA TECH NUS

FIELD TASK/HEALTH & SAFETY PLAN MODIFICATION REQUEST FORM

<u>NTC Great Lakes, Great Lakes, Illinois</u> Project/Installation Name	<u>0154</u> CTO & Project Number	 Task Modification Number
Modification to (e.g. HASP & Section, WP, SAP, Specifications, etc.)	Site Location	Date of Request
Activity Description: _____ _____ _____ _____ _____		
Reason for Change/Modification: _____ _____ _____ _____		
Recommended Disposition: _____ _____ _____ _____ _____		
<div style="display: flex; justify-content: space-between;"> <span>Site Safety Officer (Signature) _____</span> <span>Date (Resolution Required By) _____</span> </div>		
Approved/Disapproved Disposition (Please provide written explanation): _____ _____ _____		
<div style="display: flex; justify-content: space-between;"> <span>Health Safety Manager (Signature) _____</span> <span>Date _____</span> </div>		
<div style="display: flex; justify-content: space-between;"> <span>Accepted By Contractor/Subcontractor Representative (Signature) _____</span> <span>Date _____</span> </div>		
Distribution: <div style="display: flex; justify-content: space-between;"> <div>           Program/Project File            Project/Task Order Manager         </div> <div>           Other: _____            _____         </div> </div>		

## TABLE OF CONTENTS

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
<b>1.0 INTRODUCTION.....</b>	<b>VII-1</b>
1.1 KEY PROJECT PERSONNEL AND ORGANIZATION .....	VII-2
1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS .....	VII-5
<b>2.0 EMERGENCY ACTION PLAN .....</b>	<b>VII-8</b>
2.1 INTRODUCTION .....	VII-8
2.2 PRE-EMERGENCY PLANNING .....	VII-9
2.3 EMERGENCY RECOGNITION AND PREVENTION .....	VII-10
2.3.1 Drilling Activities .....	VII-11
2.3.2 Fire .....	VII-12
2.3.3 Chemical Exposure.....	VII-12
2.4 SAFE DISTANCES AND PLACES OF REFUGE .....	VII-13
2.4.1 Safe Place of Refuge Selection.....	VII-13
2.4.2 Critical Operations .....	VII-13
2.5 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT...	VII-13
2.5.1 Non-Life Threatening Medical Incident (Bruises, Cuts, Scrapes, Etc.).....	VII-14
2.5.2 Life Threatening.....	VII-14
2.5.3 Emergency Medical Treatment.....	VII-14
2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES .....	VII-15
2.7 EMERGENCY CONTACTS.....	VII-16
2.8 ROUTE TO HOSPITAL .....	VII-18
2.9 PPE AND EMERGENCY EQUIPMENT .....	VII-19
2.9.1 PPE Requirements – Incidental Spill of Investigative Derived Wastes (IDW).....	VII-20
2.9.2 Fire Fighting.....	VII-20
2.10 ILLNESS/INJURY REPORTING.....	VII-21
<b>3.0 SITE BACKGROUND AND DESCRIPTION .....</b>	<b>VII-24</b>
3.1 SITE BACKGROUND AND HISTORY .....	VII-24
3.1.1 Site 7 – RTC Silk Screening Area.....	VII-24
3.1.2 Site 17 – Pettibone Creek/Boat Basin .....	VII-25
<b>4.0 SCOPE OF WORK .....</b>	<b>VII-26</b>
4.1 MOBILIZATION/DEMOBILIZATION.....	VII-26
4.2 PERMANENT MONITORING WELL INSTALLATION – HOLLOW STEM AUGER.....	VII-27
4.2.1 Permanent Monitoring Well Development and Hydraulic Conductivity Testing.....	VII-27
4.2.2 Monitoring Well and Piezometer Abandonment .....	VII-28
4.3 MULTI-MEDIA SAMPLING.....	VII-29
4.3.1 Surface and Subsurface Soil Sampling .....	VII-29
4.3.2 Water Level Measurements.....	VII-30
4.3.3 Monitoring Well Sampling.....	VII-30
4.3.4 Surface Water and Sediments .....	VII-31
4.3.5 Investigation Derived Waste Management.....	VII-31
4.4 GEOGRAPHICAL/GEOPHYSICAL SURVEYING .....	VII-32
4.5 DECONTAMINATION .....	VII-32
4.5.1 Sampling Equipment.....	VII-32

## TABLE OF CONTENTS (Continued)

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
<b>5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION .....</b>	<b>VII-34</b>
5.1 GENERAL SAFE WORK PRACTICES .....	VII-34
5.2 DIRECT PUSH TECHNOLOGIES SAFE WORK PRACTICES .....	VII-36
5.2.1 Before Drilling .....	VII-36
5.2.2 During Drilling .....	VII-36
5.2.3 After Drilling .....	VII-37
<b>6.0 HAZARD ASSESSMENT .....</b>	<b>VII-45</b>
6.1 CHEMICAL HAZARDS .....	VII-45
6.2 PHYSICAL HAZARDS .....	VII-48
6.2.1 Slips, Trips, and Fall Hazards .....	VII-48
6.2.2 Strains/Muscle Pulls .....	VII-49
6.2.3 Noise In Excess of 85 dBA .....	VII-50
6.2.4 Exposure to Pinch or Compression Points and/or Entanglement or Contact with Moving or Rotating Equipment/Machinery .....	VII-50
6.2.5 Contact with Energized, Including Operating Processes and Utilities Systems (Aboveground and Underground) .....	VII-52
6.2.6 Heat/Cold Stress .....	VII-53
6.2.7 Cuts/Lacerations .....	VII-54
6.3 NATURAL HAZARDS .....	VII-54
6.3.1 Insect Bites and Stings .....	VII-54
6.3.2 Snakes and Other Wild Animals .....	VII-56
6.3.3 Poisonous Plants .....	VII-57
6.3.4 Inclement Weather .....	VII-58
6.4 WATER HAZARDS .....	VII-58
<b>7.0 HAZARD MONITORING .....</b>	<b>VII-59</b>
7.1 TASKS TO BE CONDUCTED .....	VII-59
7.2 ASSOCIATED HAZARDS .....	VII-59
7.3 INSTRUMENTS TO BE USED FOR HAZARD MONITORING .....	VII-61
7.3.1 Metrosonics dB-307 Noise Dosimeter/ or Equivalent .....	VII-61
7.3.2 Chemical Contaminant Monitoring .....	VII-61
7.4 INSTRUMENT MAINTENANCE AND CALIBRATION .....	VII-62
<b>8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS .....</b>	<b>VII-64</b>
8.1 INTRODUCTION/REFRESHER/SUPERVISORY TRAINING .....	VII-64
8.1.1 Requirements for TtNUS Personnel .....	VII-64
8.1.2 Requirements for Subcontractors .....	VII-64
8.2 SITE-SPECIFIC TRAINING .....	VII-66
8.3 MEDICAL SURVEILLANCE .....	VII-66
8.3.1 Medical Surveillance Requirements for TtNUS Personnel .....	VII-66
8.3.2 Medical Surveillance Requirements for Subcontractors .....	VII-68
8.3.3 Requirements for All Field Personnel .....	VII-68
8.4 SUBCONTRACTORS EXCEPTIONS .....	VII-68

## TABLE OF CONTENTS (Continued)

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
<b>9.0 SITE CONTROL .....</b>	<b>VII-72</b>
9.1 EXCLUSION ZONE .....	VII-72
9.1.1 Exclusion Zone Clearance .....	VII-72
9.2 CONTAMINATION REDUCTION ZONE .....	VII-73
9.3 SUPPORT ZONE .....	VII-74
9.4 SAFE WORK PERMITS .....	VII-74
9.5 SITE VISITORS .....	VII-76
9.5.1 Base Pass and Security .....	VII-77
9.6 SITE SECURITY .....	VII-77
9.7 SITE MAP .....	VII-78
9.8 BUDDY SYSTEM .....	VII-78
9.9 MATERIAL SAFETY DATA SHEETS (MSDS) REQUIREMENTS .....	VII-78
9.10 COMMUNICATION .....	VII-78
9.11 SANITATION AND BREAK AREAS .....	VII-78
9.11.1 Toilets .....	VII-79
9.11.2 Potable Water .....	VII-79
9.11.3 Showers and Change Rooms .....	VII-79
9.11.4 Break Areas .....	VII-79
<b>10.0 SPILL CONTAINMENT PROGRAM .....</b>	<b>VII-80</b>
10.1 SCOPE AND APPLICATION .....	VII-80
10.2 POTENTIAL SPILL AREA .....	VII-81
10.3 CONTAINMENT AREAS .....	VII-81
10.3.1 Waste Storage .....	VII-81
10.3.2 Flammable/POL Storage .....	VII-81
10.4 MATERIALS HANDLING .....	VII-82
10.5 LEAK AND SPILL DETECTION .....	VII-82
10.6 PERSONNEL TRAINING AND SPILL PREVENTION .....	VII-82
10.7 SPILL PREVENTION AND CONTAINMENT EQUIPMENT .....	VII-82
10.8 SPILL CONTAINMENT/CONTROL RESPONSE PLAN .....	VII-83
<b>11.0 CONFINED SPACE ENTRY .....</b>	<b>VII-85</b>
<b>12.0 MATERIALS AND DOCUMENTATION .....</b>	<b>VII-86</b>
12.1 MATERIAL TO BE POSTED AT THE SITE .....	VII-86
<b>13.0 GLOSSARY .....</b>	<b>VII-88</b>
ATTACHMENT I -	INJURY/ILLNESS PROCEDURE AND REPORT FORM
ATTACHMENT II -	SOP FOR UTILITY LOCATING AND EXCAVATION CLEARANCE
ATTACHMENT III -	EQUIPMENT INSPECTION CHECKLIST
ATTACHMENT IV -	SAFE WORK PERMITS
ATTACHMENT V -	MEDICAL DATA SHEETS
ATTACHMENT VI -	HEARING CONSERVATION PROGRAM AND OCCUPATIONAL NOISE EXPOSURE STANDARD
ATTACHMENT VII -	FIRE EXTINGUISHER USE AND INSPECTION



## TABLES

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
2-1 Emergency Contacts .....	VII-17
5-1 Tasks/Hazards/Control Measures Compendium .....	VII-39

## FIGURES

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
2-1 Emergency Response Protocol .....	VII-22
7-1 Documentation of Field Calibration.....	VII-63
8-1 Training Letter .....	VII-65
8-2 Site-Specific Training Documentation .....	VII-67
8-3 Subcontractor Medical Approval Form .....	VII-69
8-4 Medical Surveillance Letter .....	VII-71
9-1 Safe Work Permit .....	VII-75

## 1.0 INTRODUCTION

**Authorization:** This Health and Safety Plan (HASP) and the work described within are completed under the authorization of:

Contract: Comprehensive Long-Term Environmental Action Navy (CLEAN III)  
Contract Number: N62467-94-D-0888  
Contract Task Order: 0154  
Statement of Work Number: 0173  
Proposed Dates of Work: August 2001 to October 2001

**Application:** This Health and Safety Plan (HASP) has been written to encompass site activities that are to be conducted at properties associated with Naval Training Center (NTC) Great Lakes, located in Great Lakes, Illinois, as part of Contract Task Order (CTO) 0154. Specifically, this HASP addresses the remedial investigation activities to be conducted at Site 7 RTC Silk Screening Area and Site 17 Pettibone Creek/Boat Basin.

It is the intent and purpose of this HASP to provide project organization and responsibilities, as well as, policy, procedures, safe work practices, and guidelines necessary to protect site workers, and the general population from chemical, physical, and biological hazards associated with the planned site activities. It is through the execution of the elements defined within this HASP that efforts will be directed to minimize potential incidents and associated injury.

Site activities to be conducted at NTC Great Lakes at Sites 7 & 17 include the following (see Section 4.0 for a detailed description):

- Mobilization/demobilization
- Monitoring Well Installation/Construction/Abandonment. Methods employed include:
  - Direct Push Technique
  - Hollow Stem Auger
- Multi-media Sampling including:
  - Surface soil sampling
  - Subsurface soil sampling (well installation)
  - Ground water sampling

- New temporary monitoring wells
- Surface water/sediment sampling
- Equipment decontamination
- Aquifer Testing – Slug Testing
- Ground water level measurements
- Investigation-derived waste handling and disposal
- Site Restoration
- Land Surveying of Sample Locations

**Compliance:** The elements of this HASP are intended to be in compliance with the requirements established by:

- OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)
- Applicable sections of 29 CFR 1926 "Safety and Health Regulations for Construction."
- Tetra Tech NUS Health and Safety Program
- Applicable NTC Great Lakes Policy and procedures

**Modifications/Changes:** The following conditions are considered sufficient basis for change and will serve as triggers to institute review and possible changes to this document

- The addition of activities outside of those specified in Section 4.0, Scope of Work.
- Task Modifications to those activities specified within Section 4.0, Scope of Work.
- New information becomes available through the course of the investigation and/or from outside sources.

All changes to this HASP will be requested through the Task Order Manager (TOM) to the Tetra Tech NUS Health and Safety Manager (HSM) using the Tetra Tech NUS, Inc. Field Task/Health & Safety Plan Modification Request Form. It is the responsibility of the TOM to notify all affected personnel of all changes to this HASP. Changes to the HASP will be documented using a Document Review Record.

## **1.1 KEY PROJECT PERSONNEL AND ORGANIZATION**

This section defines responsibility for site safety and health for TtNUS and subcontractor employees engaged in onsite activities. Personnel assigned to these positions will exercise the primary responsibility for all onsite health and safety. These persons will be the primary points of contact for any questions

regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities.

- The TtNUS TOM is responsible for the overall direction of health and safety for this project. This includes but is not limited to, the following duties
  - i. Prepares background review - Results from past investigation activities at NTC Great Lakes, Great Lakes, Illinois (pertinent data - peak concentrations/exceedances by site media for each contaminant at each location of the investigation).
  - ii. Defines the specific scope of work to be performed.
  - iii. Determines the appropriate points of contact within NTC Great Lakes (i.e., Base Contact, Base Security, Utilities, Emergency notification procedures, closest hospital, Facility Emergency Response capabilities, etc.)
  - iv. Obtains site access, not only to the base, but also to files and records that may have some bearing or pertinence pertaining to this project.
- The Project Health and Safety Officer (PHSO) is responsible for developing this HASP in accordance with internal and external requirements. Specific responsibilities include:
  - i. Providing information regarding site contaminants and physical hazards associated with the site.
  - ii. Establishing air monitoring and decontamination procedures.
  - iii. Assigning personal protective equipment based on task and potential hazards.
  - iv. Determining emergency response procedures.
  - v. Stipulate training and appropriate medical surveillance requirements for Tetra Tech NUS and subcontractor personnel.
  - vi. Providing standard work practices to minimize potential injuries and exposures associated with the project scope of work.
  - vii. Modifies this HASP, if/as necessary.
- The TtNUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed Site Safety Officer. The FOL manages field activities, executes the work plan, and enforces safety procedures. as applicable to the work plan.
- The Site Safety Officer (SSO) supports site activities by advising the FOL on all aspects of health and safety on-site. These duties may include:

- i. Coordinating all health and safety activities with the FOL.
  - ii. Selecting, applying, inspecting, and maintenance of personal protective equipment.
  - iii. Establishing work zones and control points in areas of operation.
  - iv. Implementing air monitoring program for on-site activities.
  - v. Verifies training and medical clearance of on-site personnel status in relation to site activities.
  - vi. Implementing Hazard Communication and other associated health and safety programs, as they may apply to site activities.
  - vii. Coordinating emergency services.
  - viii. Providing site-specific training for all onsite personnel.
  - ix. Investigating all accidents and injuries (see Attachment I - Illness/Injury Procedure and Report Form)
  - x. Providing input to the PHSO regarding the need to modify this HASP, or applicable health and safety associated documents.
- Compliance with the requirements stipulated in this HASP are monitored by the SSO and coordinated through the TtNUS CLEAN HSM and PHSO.

**NOTE: IN SOME CASES ONE PERSON MAY BE DESIGNATED RESPONSIBILITIES FOR MORE THAN ONE POSITION. FOR EXAMPLE, AT NTC GREAT LAKES, THE FOL MAY ALSO BE RESPONSIBLE FOR THE SSO DUTIES. THIS ACTION WILL BE PERFORMED ONLY AS CREDENTIALS, EXPERIENCE, AND AVAILABILITY PERMITS.**

## 1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

**Site Name:** NTC Great Lakes

**Address:** EFA Midwest  
Building 1A, Code N457  
201 Decatur Avenue  
Great Lakes, IL 60088

**NTC Great Lakes Point of Contact:** Bryan Holtrop

**Phone Number:** (847) 688-5997 Ext. 57

**Fax Number:** (847) 688-2319

**E-Mail:** HoltropBK@efdsouth.navfac.navy.mil

**U.S. Navy Remedial Project Manager/Engineer-In-Charge:** Anthony Robinson (Code 18511)

**Address:** 2155 Eagle Drive  
North Charleston, South Carolina 29406

**Phone Number:** (843) 820-7339

**Fax Number:** (843) 820-7465

**E-mail Address:** robinsonab@efdsouth.navfac.navy.mil

**Base Pass and Security:** Building 130 (near Main Gate); Hours of Operation 0600 – 1800

**Phone Number:** (847) 688-5648

Note: See Section 9.5.1 for Base Access Information.

**Purpose of Site Visit:** This activity is divided into a multi-task operation (see Section 4.0), including Direct Push Technology [DPT] soil borings, temporary monitoring well installation, and multi-media sampling, and other related activities.

**Proposed Dates of Work:** June 2001 until completed

### **Project Team:**

#### **Tetra Tech NUS Personnel:**

#### **Discipline/Tasks Assigned:**

#### **Phone No.**

Robert Davis, P.E.

Task Order Manager

(412) 921-7251  
davisb@ttnus.com

Aaron Bernhardt

Assistant Task Order Manager/Ecological

(412) 921-8433  
bernhardta@ttnus.com

Matthew M. Soltis, CIH, CSP

CLEAN Health and Safety Manager

(412) 921-8912  
soltism@ttnus.com

<u>Thomas M. Dickson, CSP</u>	<u>Project Health and Safety Officer</u>	<u>(412) 921-8457</u> <u>dickson@ttnus.com</u>
<u>Bob Balkovec</u>	<u>Project Geologist/Field Operations Leader (FOL)</u>	<u>(412) 921-8616</u> <u>balkovecb@ttnus.com</u>
<u>TBD</u>	<u>Site Safety Officer (SSO)</u>	
<u>Tom Patton</u>	<u>Equipment Manager</u>	<u>(412) 859-4670</u>

**Project Support Team:**

<b>Tetra Tech NUS Personnel:</b>	<b>Discipline/Tasks Assigned:</b>	<b>Phone No./E-mail</b>
<u>Tom Jackman</u>	<u>Human Health Risk Assessment</u>	<u>(412) 921-8724</u> <u>jackmant@ttnus.com</u>
<u>Angie Scheetz</u>	<u>Project Chemist</u>	<u>(412) 921-7271</u> <u>scheetza@ttnus.com</u>
<u>Mike Kuhn</u>	<u>GIS/Database/Information Technology</u>	<u>(412) 921-8942</u> <u>kuhnm@ttnus.com</u>
<u>Tom Johnston</u>	<u>DQOs, QAPP</u>	<u>(412) 921-8615</u> <u>johnstont@ttnus.com</u>

<b>Non-Tetra Tech NUS Personnel</b>	<b>Affiliation/Discipline/Tasks Assigned</b>	<b>Phone No#.</b>
<u>Veronica Bortot</u>	<u>Analytical Laboratory (STL- Pittsburgh)</u>	<u>(412) 820-2148</u>
<u>Harlan Doland</u>	<u>Surveyor (Geographical) (McClure Eng)</u>	<u>(847) 336-7100</u>
<u>Robert Gay</u>	<u>Patrick Drilling Inc.</u>	<u>(630) 963-7474</u>
<u>FedEx</u>	<u>Sample/Parcel Delivery</u>	<u>1(800)463-3339</u>

**Project Regulatory Oversight/Support:**

<b>U.S. EPA Region 5, EPA RPM:</b>	Thompson, Owen	<b>Phone Number:</b>	(312) 886-4843
<b>Address:</b>	77 W. Jackson Blvd	<b>Fax Number:</b>	(312) 353-8426
	Chicago, IL 60604-3507	<b>E-mail:</b>	thompson.owen@epa.gov

<b>IL EPA, Bureau of Land,</b>		<b>Phone Number:</b>	(217) 557-8155
<b>IL RPM:</b>	Conrath, Brian	<b>Fax Number:</b>	Not Available
<b>Address:</b>	1021 N. Grand Avenue East	<b>E-mail:</b>	brian.conrath@epa.state.il.us
	Springfield, IL 62702		

**IL EPA**

**IL Office of Chemical Safety**

**Environmental Toxicologist:**

**Address:**

Morrow, Leslie  
1021 N. Grand Avenue East  
Springfield, IL 62702

**Phone Number:** (217) 782-9292

**Fax Number:** (217) 782-3258

**E-mail:** les.morrow@epa.state.il.us

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation conducted by:

Thomas M. Dickson, CSP

---



## 2.0 EMERGENCY ACTION PLAN

### 2.1 INTRODUCTION

This section of the HASP is part of a preplanning effort to direct and guide field personnel in the event of an emergency. The first measure in accomplishing this objective is to define, what is and is not, an emergency.

An emergency is defined in 1910.120 is:

*An occurrence or condition that can or has resulted in an uncontrolled release of a hazardous substance or potential safety hazard (i.e., fire, explosion, chemical exposure) associated with that release.*

An incidental release is defined in 1910.120 is:

*The releases of a hazardous substance that can be absorbed, neutralized, or otherwise controlled and will not result in potential safety hazard (i.e., fire, explosion, chemical exposure) are not considered emergency responses.*

Based on the above definitions, TtNUS will, through necessary services, include initial response measures for incidents such as:

- Initial fire-fighting support and prevention
- Initial spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provision of initial medical support for injury/illness requiring only first-aid level support
- Provision of site control and security measures as necessary

Incidents and conditions above this level of participation are and will be considered emergencies. These events are considered beyond the capabilities of field personnel and available resources to provide emergency response safely. Therefore, the emergency response agencies listed in this plan are capable of providing the most effective response, and as such, will be designated as the primary responders in the event of an emergency. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time.

NTC Great Lakes Emergency Dispatch will be notified anytime outside response agencies are contacted. This Emergency Action Plan conforms to the requirements of 29 CFR 1910.38(a), as allowed in 29 CFR 1910.120(l)(1)(ii).

## **2.2 PRE-EMERGENCY PLANNING**

Through the initial hazard/risk assessment effort, injury or illness resulting from exposure to chemical, physical hazards, or fire are the most probable emergencies that could potentially be encountered during site activities. To minimize and eliminate these potential emergency situations, pre-emergency planning activities associated with this project include the following. The SSO and/or the FOL are responsible for:

- Coordinating response actions with NTC Great Lakes Emergency Services personnel to ensure that TtNUS emergency action activities are compatible with existing facility emergency response procedures. This will require the FOL and/or the SSO to review these emergency actions with the appointed Emergency Response Providers, prior to the commencement of on-site activities.
- Establishing and maintaining information at the project staging area (Support Zone) for easy access in the event of an emergency. This information includes the following:
  - Chemical Inventory (for substances used onsite), with Material Safety Data Sheets.
  - Onsite personnel medical records (medical data sheets).
  - A logbook identifying personnel onsite each day.
  - Emergency notification phone numbers in all site vehicles
- Identifying a chain of command for emergency action. For this field effort, the FOL and/or the SSO shall serve as Incident Coordinators in the event of an incidental release. In the event the release cannot be controlled, Incident Command will be passed to the responding emergency services agency.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible. This will be accomplished through site-specific training of this emergency action plan, HASP, and through daily briefings and issuance of the Safe Work permits.

## **2.3 EMERGENCY RECOGNITION AND PREVENTION**

The primary focus of this section is the ability to recognize and control factors that could contribute to an emergency situation/condition. The FOL and/or the SSO will preview all site work location, prior to committing personnel or resources. Their actions will be as follows:

- Identify, remove, and/or barricade physical hazards within the estimated work area. Ensure that approach paths and access and control points into the work area have been established to ensure that pedestrian and vehicle traffic and other installation activities are not impacted by site operations.
- Provide the necessary equipment to control potential emergencies (i.e., safety cans for flammable liquid storage, spill containment equipment, PPE, and emergency equipment such as portable fire extinguishers, first-aid kits). Ensure emergency equipment and resources are at the ready, should they be needed for incidental response measures.
- Evaluate operations to ensure that necessary measures are taken to control and/or minimize the impact of emergency situations/conditions. This includes actions such as, but not limited to,
  - Securing the necessary permits and clearances such as Utility and Excavation Clearances provided by the Base Public Works (Note: The Public Works Dept. will serve as the liaison between the Base and the Illinois One-Call Utility Clearance System. When utility clearances are obtained you will need to secure paper copies, ticket numbers, etc. All utility clearance should be obtained through the Base Contact. All utility clearances are good for 14-days from the date of issue. If the work will not be completed in that time frame, extensions may be requested).
  - Ensure all personnel are adequately trained in the provisions of this HASP and this Emergency Action Plan.
- Complete site characterization for all predetermined work in contaminated areas to quantify and qualify the hazards associated with those areas. Areas will be demarcated and restricted to only approved personnel based on the results obtained from this site characterization.

Field Crew shall:

- At the FOL and/or the SSO's direction, remove or barricade physical hazards within the estimated work area identified by the FOL and/or the SSO.
- Follow the guidelines for control of emergency conditions.

- Report any potential emergency situation to the FOL and/or the SSO.

It is recognized through the following activities that an emergency has the potential to occur and prevention will be initially directed to control those situations.

### **2.3.1     Drilling Activities**

The potential emergencies that could result during this activity are primarily physical in nature. They include being struck by the equipment, entanglement into rotating machinery, striking an underground utility and associated traffic hazards. The control measures to be put in place to minimize these occurrences are as follows:

**Traffic Patterns in and around the drilling area** – Traffic for heavy equipment and pedestrians shall be separated by flow patterns. All heavy equipment (drill rigs and support vehicles) shall be routed in a singular direction to minimize backing, U-turns, and other maneuvers that could result in an accident. A demarcation area shall be established in plain view, so all personnel recognize the boundary of potential physical hazards. Boundaries established to control hazards of this nature are as follows:

- Hollow-Stem Auger (HSA) Drilling Operation - The height of the mast plus five feet. At this distance non-essential personnel will be removed from the identified impact area of potential physical hazards such as the mast collapsing, cables releasing/breaking, as well as, potential chemical exposure. All personnel not directly supporting this operation shall remain outside of this designated/demarcated area.
- Direct Push Technologies - The height of the mast plus five feet or a minimum distance of 25-feet. At this distance non-essential personnel will be removed from the identified impact area of potential physical hazards such as the mast collapsing or high pressure releases from the hydraulic operating system.

**Entanglement in Rotating Equipment** – This is considered a significant hazard associated with HSA activities. Many of the recorded fatalities within the drilling industry have been associated with entanglement within the spinning augers. The reasons associated with this hazard has been snag points on the rotating apparatus, as well as, the existence of loose clothing, jewelry and long hair. This has been compounded by inoperable emergency stop devices. Recognition and control shall focus on these aspects through equipment inspection and removal or securing of potential snag items at the work site. This is not a significant hazard associated with the DPT operation. It however, does exist to a limited application during the DPT's coring through concrete, asphalt, or other dense material. It is addressed here only as a

reminder. Other hazards of this nature shall be avoided through strict adherence to the safe work practices described in Section 5.2.

**Contact with Energized Systems** – Much of the work to be done at NTC Great Lakes are to be conducted within light industrial areas supported by underground and overhead energy sources. Preliminary efforts to control hazards of this nature will include:

- Use and application of Attachment II, Standard Operating Procedure (SOP) for Utility Locating and Excavation Clearance. This procedure provides step by step instructions for clearance of underground utilities, as well as, avoidance techniques, and required documentation.
- Establishing a suitable clearance distance from overhead utilities as a primary method to control hazards conveyed through contact with these power sources.

Of primary concern associated with this hazard is electrocution. Electricity seeks the path of least resistance to complete the circuit and go to ground. In the evaluation of this hazard, the driller completes this link through contact with the controls and the ground if the rig becomes energized through contact or arcing of overhead lines or contact with buried utilities. In areas prone to this hazard, the driller shall be asked to utilize a non-conductive material such as wood or rubber matting as a work platform to break this link when contact would occur.

### **2.3.2      Fire**

There is limited potential for fire during this operation and most associated with resource deployment (fueling equipment and decontamination solvents). Fire protection and prevention methods will be followed as specified in Section 2.9.2.

### **2.3.3      Chemical Exposure**

Given the reported chemical concentrations of site contaminants and the proposed work activities associated with the scope of work, emergency situations involving potential exposures are unlikely to occur. Additionally, use of required control measures, air monitoring, personal protective equipment usage and decontamination efforts will further reduce the potential for exposures to site contaminants.

## **2.4 SAFE DISTANCES AND PLACES OF REFUGE**

### **2.4.1 Safe Place of Refuge Selection**

The FOL and/or the SSO shall identify a safe place of refuge (in the event of an emergency) on the Safe Work Permit (See Attachment IV). This location will be selected and conveyed to the Field Crew, as part of issuing the Safe Work Permit at the beginning of each field task and at each location, where the primary and alternate safe place of refuge may change. Selection will be based on the following considerations:

- A location providing telephone communications and/or shelter.
- A location from which the field crews can provide site security restricting access to the emergency area, however, a point from which the field crew may direct emergency response personnel (i.e., intersection or gate, etc.).

In all cases this location should be positioned a sufficient (safe) distance from the operation whereas not to be impacted by the emergency. This distance is impacted by a number of conditions (i.e., tasks being conducted; chemical, physical, and toxicological properties; potential for fire and explosion; meteorological conditions; terrain). Based on the level of reported contaminants and the types of contaminants, it is not anticipated that the area to be secured in the event of an emergency will extend above those specified in Section 9.1.1 (Exclusion Zone).

### **2.4.2 Critical Operations**

There are no operations being conducted under this scope of work that are considered critical and would require an individual or individuals to man during an emergency. Therefore in the event of an emergency all personnel will cease all operations and report to the safe place of refuge.

## **2.5 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT**

During an evacuation, decontamination procedures will be performed only, if doing so does not further jeopardize the welfare of site workers. However, it is unlikely that an emergency would occur which would require workers to evacuate the site without first performing decontamination procedures. Decontamination of medical emergencies will proceed in the following manner.

### **2.5.1      Non-Life Threatening Medical Incident (Bruises, Cuts, Scrapes, Etc.)**

The area of clothing or suit penetration will be isolated from the decontamination procedure by removing the protective garments or clothing surrounding the area of the injury and applying a light gauze wrap and plastic cover. Decontamination for unaffected areas will proceed as per Table 5-1 of this HASP.

### **2.5.2      Life Threatening**

- Notify off-site response agencies.
- If it will not endanger the injured individual (i.e., spinal cord injury, etc.) remove any outer PPE. Removal may require the use of bandage scissors to remove the outer garments.
- Begin life saving techniques as appropriate (CPR, cooling or warming regimens, etc.).
- Wrap the injured in a blanket for transport to the hospital.
- Engage Emergency Notification Sequence
- Follow instructions provided in Figure 2-1.

**Note:** One person from the field team will accompany the injured to the hospital with his/her medical data sheet, appropriate MSDSs (if applicable), a copy of this HASP, and the incident forms. This person will collect as much information, as possible, and transfer that information to the HSM and Work Care as per the Incident Response Protocol provided in Figure 2-1. All other personnel will engage site control/site security measures.

The SSO upon insuring care for the injured party will engage an investigation of the incident to gather as much information as possible. This includes as a minimum answering the questions Who? What? Where? When? Why? and How?. This information will then be communicated to the TOM and the HSM. Attachment I Tetra Tech NUS, Inc. Injury/Illness Procedure will be used to accomplish this task.

### **2.5.3      Emergency Medical Treatment**

Tetra Tech NUS and subcontractor personnel are only permitted to provide treatment to the level of their First-Aid Training. It should also be noted all first aid shall be administered voluntarily. All First-Aid provided will incorporate the following protective measures:

Emergency medical treatment will be initiated under the following guarded restrictions:

- Notify the FOL and/or the SSO of the incident.

- Take the necessary precautions to prevent direct contact with the injured person's body fluids. This may be accomplished through the employment of the following measures:
  - Use surgeons gloves when handling cuts, abrasions, bites, punctures, etc. or any part of the injured person. The use of safety glasses and surgeons masks maybe necessary, if there is the potential for uncontrolled spread of body fluids. The PHSO will be immediately notified in event that personnel providing emergency first-aid come into contact with body fluids or other potentially infectious tissues.
  - Should Cardio-Pulmonary Resuscitation (CPR) be required, use a CPR Micro-Shield mouthpiece when administering CPR to prevent contact with the injured person's body fluids.

In order to engage these protective measures the FOL shall insure that these items are part of their first-aid kit.

## **2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES**

Since TtNUS personnel will not always be working in the proximity of each other, hand signals, voice commands, air horns, and/or two-way radios may comprise the mechanisms to alert site personnel of an emergency.

If an incident occurs, site personnel will initiate the following procedures:

- Initiate incident alerting procedures (if needed) verbally, by air horn, or using two-way radios.
- Evacuate non-essential personnel.
- Initiate initial response procedures.
- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred in as much detail as possible.

In the event that site personnel cannot control the incident through offensive and/or defensive measures, the FOL and/or the SSO will enact emergency notification procedure to secure additional outside assistance in the following manner:

- Call 911 for outside emergency service and report the emergency to the NTC Great Lakes Emergency Dispatch (See Table 2-1)

Note: All cellular phone calls are routed through the Lake County Dispatch. It will be necessary to inform the dispatch that your are at the NTC Great Lakes Facility.



- Give the emergency operator the location of the emergency and a brief description of what has occurred.
- Stay on the phone and follow the instructions given by the operator.
- The appropriate agency will be notified and dispatched.

If an incident occurs outside of our designated operating areas impacting field personnel, the following procedures are to be initiated:

- Initiate an evacuation (if needed) by voice commands, hand signals, air horns, or two-way radio.
- Call Navy On-Site Representative [Bryan Holtrop at (847) 688-5997 Ext. 57.]
- Proceed to the assembly points as directed by NTC Great Lakes Emergency Services or other designated Navy personnel.

## **2.7 EMERGENCY CONTACTS**

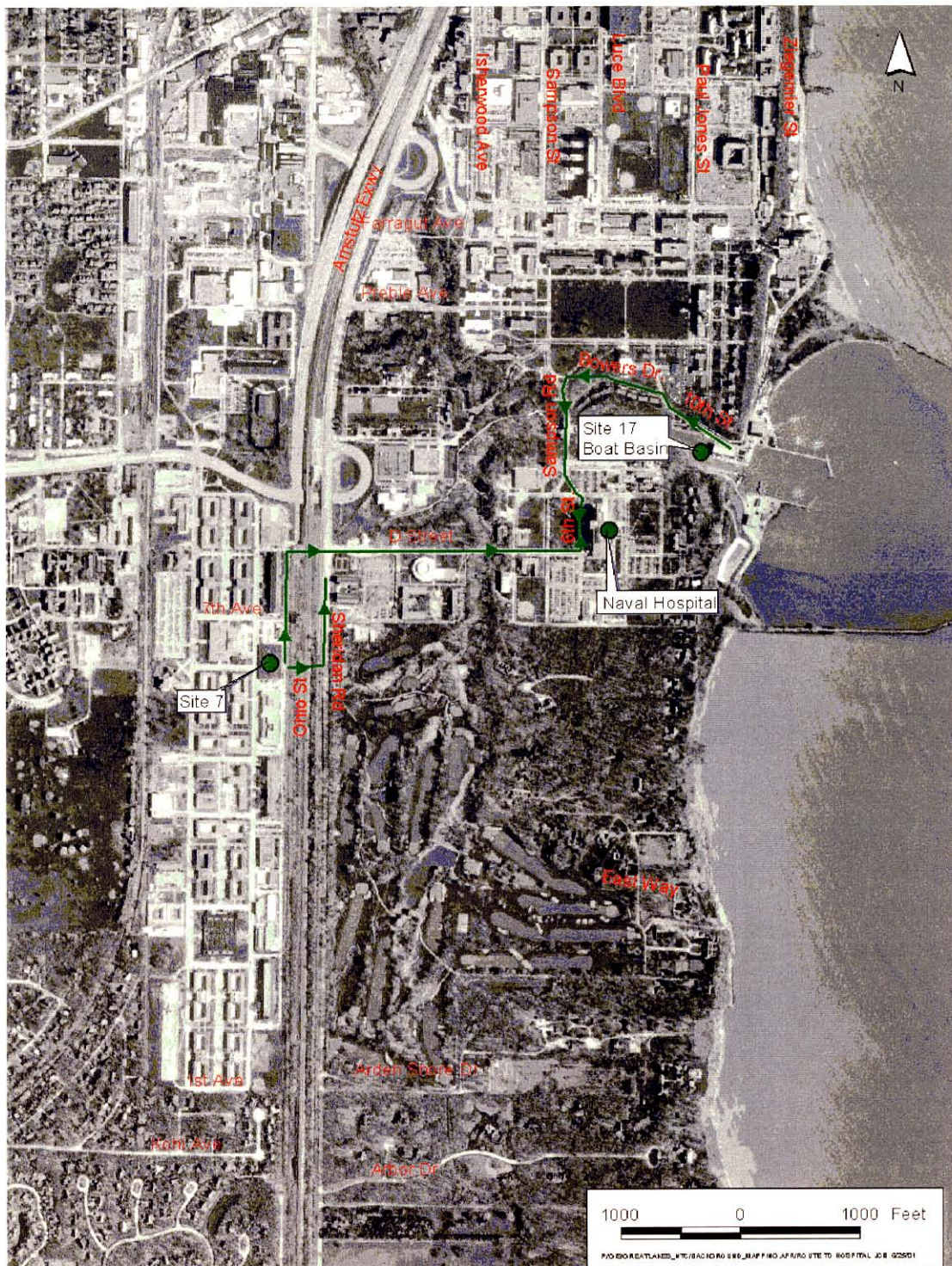
Prior to performing work at the site, all personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an incident. A mobile phone shall be available on site. Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table must be posted on site where it is readily available to all site personnel.

**TABLE 2-1**  
**EMERGENCY CONTACTS**  
**NTC GREAT LAKES**

<b>AGENCY</b>	<b>TELEPHONE</b>
EMERGENCY (Police, Fire, and Ambulance Services)	911*
Non-Emergency (Police, Fire, and Ambulance Services)	(847) 688-3430
U.S. Navy Remedial Project Manager/Engineer-in-Charge – Mr. Anthony Robinson	(843) 820-7339
U.S. Navy/NTC Great Lakes Point of Contact – Mr. Bryan Holtrop	(847) 688-5997 Ext. 57
Great Lakes Naval Hospital (Primary)	911 (Primary) (847) 688-4560 Duty Officer (847) 688-5555 Ambulance (847) 688-5618 Emergency
TtNUS Task Order Manager - Robert Davis	(412) 921-7251
CLEAN Health and Safety Manager – Matthew M. Soltis	(412) 921-8912
Project Health and Safety Officer - Tom Dickson	(412) 921-8457
WorkCare (TtNUS Healthcare Provider)	1-800-455-6155 Ext. 109 Fax (714) 456-2154
Utility Location (15 Working Days Advance Notification Required) Ms. Judy Jarosz (Primary) Mr. Chuck Kelly (Back-up)	(847) 688-2121 Ext. 18 (847) 688-2121 Ext. 10
Utility Emergency – Public Works Dept. – NTC Great Lakes (Monday – Friday 0700 – 1630)	(847) 688-3849
Trouble Desk (Holidays and Saturday/Sundays)	(847) 688-4820

\* - Cellular communications will be routed through Lake County Dispatch. It is imperative that you inform them that you are calling from the NTC Great Lakes facility. 911 will work from any Base extension.

## 2.8 ROUTE TO HOSPITAL



For emergency care only, non-Navy personnel are permitted to go to the Navy Hospital.

Great Lakes Naval Hospital  
3001A Sixth Street  
Great Lakes, Illinois 60088-2833  
(Sheridan Road and South Gate Entrance)

(847) 688-4560 Duty Officer  
(847) 688-5555 Ambulance  
(847) 688-5618 Emergency

#### **From Site 7 – RTC Silk Screening Area**

1. Exit Site 7 Turn Left onto Sheridan Road (North) to the South Gate Entrance (Avenue D) turn right into the South Gate Entrance.
2. Proceed east on D Avenue to Sixth Street, turn left onto Sixth Street (The hospital is on the right)
3. Follow signs to the appropriate entrance to the hospital (3001A Sixth Street).

#### **From Site 17 – Pettibone Creek/Boat Basin – From the Inner Harbor and Boat Basin (Building 13)**

1. Turn left (west) onto Mahan Rd, travel approximately 0.12 miles to Bowers Drive.
2. Bear left onto Bowers Drive, travel due west approximately 0.15 miles to Sampson Road, turn left.
3. Proceed on Sampson Road (south), travel approximately 0.18 miles to B Street, turn left, then an immediate right onto Sixth Street, the hospital is on the left.

The Building 13 location has been selected as a point of reference for a site that extends Base wide. Personnel should evaluate the most feasible hospital routes from identified areas along Pettibone Creek should their work take them into these areas.

**Note:** Transportation of injured/ill persons to the hospital is only recommended providing this action will not further aggravate the condition and/or injury. In such cases, it is recommended that the ambulance service be contacted for assistance and transportation to the hospital.

## **2.9 PPE AND EMERGENCY EQUIPMENT**

A first aid kit, eye wash units (as necessary), and fire extinguishers will be maintained on-site at an easily accessible location and shall be immediately available for use in the event of an emergency. Based on the anticipated hazards, these emergency equipment items may be maintained at the exclusion zone of on-going operations as determine and communicated to the field crew through the Safe Work Permit. This will be at the discretion of the SSO.

The FOL and/or the SSO should ensure the First-Aid Kits are stocked with the necessary equipment. All first-aid kits purchased for the job-site shall be American National Standards Institute (ANSI) Z308.1 approved for industrial applications. Additional provisions, if not included in the First-Aid Kit such as a Micro-Shield CPR mask, surgeon's mask identified within this plan will have to be secured in addition to



the kit. The SSO will determine the number of kits necessary based on the number of personnel and the number of remote operations being conducted under the scope of work. It is the SSO's responsibility to assess work site applications for specific first-aid needs based on operations being conducted and the vicinity to one another that these tasks are being conducted.

PPE levels to be used in an emergency will not exceed those items used in the completion of identified tasks. These anticipated levels of PPE are indicated below.

#### **2.9.1 PPE Requirements - Incidental Spill of Investigative Derived Wastes (IDW)**

- PVC Rain-Suits or Tyvek based on the potential for soiling work clothes during clean-up
- PVC or Neoprene Over-boots (Pant legs on the outside of the over-boots)
- Nitrile inner surgeons gloves with Nitrile outer gloves over top
- Hard hat as conditions or overhead hazards exist
- Safety Glasses
- Splash Shields as necessary

Spill equipment (identified in Section 10.0) will be maintained in the IDW storage and/or the resource deployment area to support rapid response.

#### **2.9.2 Fire Fighting**

Standard field attire will be used to combat incipient stage fires from a sufficient distance as not to endanger field personnel. Fire extinguishers will be maintained at the following locations:

- Support trailer (As applicable)
- On each piece of equipment in excess of 1 ton rating (i.e., trucks, excavator, drill rig, etc.)
- At all locations which store, dispense or otherwise handle flammable or combustible liquids.

It will be the responsibility of the SSO to ensure that enough fire extinguishers are available to support on-site operations in the vulnerable locations stated above.

All personnel will be trained in the proper use and inspection of the fire extinguishers provided by their employer for use. The training information to be provided during site-specific training may be found in Attachment VII of this document.

## **2.10 INJURY/ILLNESS REPORTING**

If any TtNUS personnel are injured or develop an illness as a result of working on site, the TtNUS "Injury/Illness Procedure" (Attachment I) must be followed. Following this procedure is necessary for documenting all of the information obtained at the time of the incident. Also, as soon as possible the Base Contact must be informed of any incident or accident that requires medical attention.

Any pertinent information regarding allergies to medications or other special conditions will be provided to medical service personnel. This information is listed on Medical Data Sheets filed on-site. If an exposure to hazardous materials has occurred, provide information on the chemical, physical, and toxicological properties of the subject chemical(s) to medical service personnel.

## **FIGURE 2-1 EMERGENCY RESPONSE PROTOCOL**

The purpose of this protocol is to provide guidance for the medical management during injury situations. In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, or follow the voice prompt after hours and on weekends and be prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved Tetra Tech NUS, Inc. employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate information to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) at 1-800-245-2730.

As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

**FIGURE 2-1 (continued)**  
**POTENTIAL EXPOSURE REPORT**

Name: \_\_\_\_\_ Date of Exposure: \_\_\_\_\_  
Social Security No.: \_\_\_\_\_ Age: \_\_\_\_\_ Sex: \_\_\_\_\_  
Client Contact: \_\_\_\_\_ Phone No.: \_\_\_\_\_  
Company Name: \_\_\_\_\_

**I. Exposing Agent**

Name of Product or Chemicals (if known): \_\_\_\_\_

Characteristics (if the name is not known)

Solid      Liquid      Gas      Fume      Mist      Vapor

**II. Dose Determinants**

What was individual doing? \_\_\_\_\_

How long did individual work in area before signs/symptoms developed? \_\_\_\_\_

Was protective gear being used? If yes, what was the PPE? \_\_\_\_\_

Was there skin contact? \_\_\_\_\_

Was the exposing agent inhaled? \_\_\_\_\_

Were other persons exposed? If yes, did they experience symptoms? \_\_\_\_\_

**III. Signs and Symptoms (check off appropriate symptoms)**

**Immediately With Exposure:**

Burning of eyes, nose, or throat

Tearing

Headache

Cough

Shortness of Breath

Chest Tightness / Pressure

Nausea / Vomiting

Dizziness

Weakness

**Delayed Symptoms:**

Weakness

Nausea / Vomiting

Shortness of Breath

Cough

Loss of Appetite

Abdominal Pain

Headache

Numbness / Tingling

**IV. Present Status of Symptoms (check off appropriate symptoms)**

Burning of eyes, nose, or throat

Tearing

Headache

Cough

Shortness of Breath

Chest Tightness / Pressure

Cyanosis

Nausea / Vomiting

Dizziness

Weakness

Loss of Appetite

Abdominal Pain

Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: \_\_\_\_\_ Worsened: \_\_\_\_\_ Remained Unchanged: \_\_\_\_\_

**V. Treatment of Symptoms (check off appropriate response)**

None: \_\_\_\_\_ Self-Medicated: \_\_\_\_\_ Physician Treated: \_\_\_\_\_



### **3.0 SITE BACKGROUND AND DESCRIPTION**

#### **3.1 SITE BACKGROUND AND HISTORY**

The Naval Training Center (NTC) Great Lakes is located in Lake County, Illinois, on the shore of Lake Michigan about 50 miles north of downtown Chicago. Dedicated in 1911, NTC Great Lakes is the only Recruit Training Command (RTC) in the United States. NTC Great Lakes is the largest military installation in Illinois and the largest training center in the U.S. Navy. NTC Great Lakes consists of approximately 1,628 acres with 1,153 buildings. Approximately 9,000 officers and personnel are stationed at NTC Great Lakes, maintaining facilities and conducting training of about 80,000 recruits annually.

##### **3.1.1 Site 7 – RTC Silk Screening Area**

Site 7 is the Recruit Training Center (RTC) Silk Screening Shop (Building 1212) located at the NTC Great Lakes bounded on the west by Indiana Street, on the north by 8<sup>th</sup> Avenue, and on the east by Ohio Street. Site 7 is located on the north end of Building 1212. This shop has been at this location since 1943. Various flags and banners that recruits use during parades, graduation, etc. were made at this shop. The shop used a variety of materials, including ink, paint, water- and oil based lacquers, enamels, mineral spirits, acetone, thinners, and photographic emulsions during this process.

The silk screening process applies ink, paint, or photographic emulsions over a silk screen pattern drawn over a hat or garment. This process allows the ink, paint, or photographic emulsion to pass through the screen, thereby dyeing the hat or garment. The ink, paint or emulsion is then screed over the pattern in multiple directions ensuring coverage and removing excess materials. Upon completion the silk screen is washed to remove any excess materials, so that it can be re-used.

The wash water from the finishing of the silk screen was allowed to drain on the unpaved ground outside of the building from a pipe draining the shop's wash water booth. The unit has operated from at least 1965 until August 1985.

It was reported in the Initial Assessment Study (IAS) conducted in 1986 that material flushed from this unit would form pools during heavy discharges and remain as such until it infiltrated into the ground, evaporated, or was washed away during periods of precipitation. It was further determined that due to the tightness of the soils within the area of the discharge and obvious staining of the soils that the most likely receptors were Pettibone Creek/Boat Basin and Harbor. Discharge to these receptors were thought to

have been accomplished through collection and transfer through the storm water drainage system leading to and discharging at Pettibone Creek.

On June 23, 1992 a gasoline spill emanating from the southeastern corner of Site 7 from Above ground Storage Tanks occurred. During the excavation and removal of the gasoline contaminated soils, a petroleum like product was encountered approximately 2-feet below ground surface (bgs). The excavation was halted and the area filled with clean fill. According to a Navy Memorandum dated July 29, 1992, a vintage World War II gasoline station may have been located in this area.

### **3.1.2      Site 17 – Pettibone Creek/Boat Basin**

Site 17 includes Pettibone Creek, the Boat Basin, and the Inner Harbor. Pettibone Creek starts as a culvert at the north end of NTC Great Lakes and flows through a branching ravine that defines the north and south branches of Pettibone Creek. Pettibone Creek generally flows eastward, eventually discharging into the Boat Basin. Pettibone Creek is approximately 6100 feet long and ranges from between 15 and 30 feet in width and from several inches to 2 feet in depth. The Boat Basin is approximately 2.6 acres and was the location for mooring recreational watercraft. However sediment has accumulated in the basin restricting access and use. The Inner harbor is approximately 5.9 acres and is occupied by floating slips for mooring recreational watercraft. Previous investigations identified contaminated sediments in Pettibone Creek, the Boat Basin, and the Inner Harbor.

A number of previous investigations have been conducted at Site 17 - Pettibone Creek/Boat Basin. The predominant contaminants indicated are metals, polycyclic aromatic hydrocarbons (PAHs), pesticides and polychlorinated hydrocarbons. The most predominant concentrations of these contaminants are associated with the northern tributary with a secondary drop out location along the shoals between the southern tributary and the harbor.

## **4.0 SCOPE OF WORK**

The following is a list of activities that are covered in this HASP for the CTO 0154 at Sites 7 – RTC Silk Screening Area and Site 17 – Pettibone Creek/Boat Basin are as follows:

- Mobilization/demobilization
- Temporary Monitoring Well Installation/Construction/Abandonment. Methods employed include:
  - Direct Push Technique
  - Hollow Stem Auger
- Multi-media Sampling including:
  - Surface soil sampling
  - Subsurface soil sampling (well installation)
  - Ground water sampling
  - Surface water/sediment sampling
  - Investigative Derived Waste sampling
- Equipment decontamination
- Aquifer Testing
- Ground water level measurements
- Investigation-derived waste handling and disposal
- Site Restoration
- Land Surveying of Sample Locations

### **4.1 MOBILIZATION/DEMOBILIZATION**

This task includes, but not limited to, the following:

- The procurement and shipping of equipment, and materials for the field investigation.
- The review of planning documents (i.e., HASP, Sampling and Analysis Plan, Work Plan, Quality Assurance Plan, Applicable SOPs, etc.).
- Site Reconnaissance to include site characterization, site preparation, the layout of sampling locations and to secure the necessary utility clearances and isolate physical hazards, where applicable. It should be noted that the Public Works Maintenance Division handles all on-Base utility clearances for ALL utilities. All utility clearances shall proceed in accordance with Attachment II, Tetra Tech NUS,

Inc. Utility Locating and Excavation Clearance Procedures. Utility clearances for NTC Great Lakes will require 15-day advance notification. Utility clearances are also required to be supported using Julie, Inc. (800) 892-0123. A 2-working day advance notification is required. Once obtained the Utility Clearance ticket is good for a period of 14-days.

- Secure, construct, or equip decontamination facilities to support the field activities.
- Secure, construct, or equip IDW storage facilities to support the field activities.

#### **4.2 PERMANENT MONITORING WELL INSTALLATION –HOLLOW STEM AUGER**

Approximately seven shallow water table monitoring wells (15 ft.) will be installed at Site 7. The objective is to determine potential groundwater impact based on previous waste handling activities. The TtNUS geologist will oversee the drilling, construction, and development of all groundwater monitoring wells. Each new well installed could be subjected to slug testing. Groundwater well installation and development procedures will be performed in accordance with TtNUS SOP GH-1.3 and GH-2.8.

This method of drilling consists of rotating augers with a hollow stem into the ground. Cuttings are brought to the surface by the rotating action of the auger. Advantages of this type of drilling include:

- Samples can be obtained while augers remain in the ground. Sampling requires the use of split-barrel or thin-wall tube samplers advanced through the hollow core of the auger.
- No drilling fluids are required.
- A well can be installed inside the auger stem and back-filled as the augers are withdrawn.

##### **4.2.1 Temporary Monitoring Well Development and Hydraulic Conductivity Testing**

All newly installed wells shall be developed prior to sampling. The purpose of well development is to stabilize and increase the permeability of the sand pack around the well screen and to restore permeability of the formation which has been reduced by the installation of the well.

The steps to develop newly installed monitoring wells are as follows:

- The depth to water and total depth of the well is measured using an M-scope or similar water level indicator.

- A surge block or submersible pump will be lowered into the screened section of the well. The surge block or pump will be rapidly lowered and raised in the well causing groundwater to flow in and out of the well screen, flushing fine sediment out of the sand-pack.
- A submersible pump or airlift hose will be lowered into the well. The monitoring wells will be pumped using a submersible pump, or by airlift.
- Field measurements consisting of pH, temperature, specific conductance, and turbidity will be performed utilizing a Horiba U10 or U-22 Water Quality Meter during the evacuation of water, at five-to-ten-minute intervals.
- Parameters will be considered stable when variations in values are within 10% of each other and pH  $\pm$  0.2 units, for three consecutive readings taken at five to ten minute intervals. Additionally, the well will be developed until the turbidity is below 10 NTUs. If water quality parameters do not stabilize after five well volumes have been removed and a non turbid sample cannot be collected, then the site geologist will document the event, notify the TOM and begin sample collection.
- The parameters will be recorded on Monitoring Well Development Record sheets.

### **Slug Testing**

Slug testing including rising head and falling head aquifer testing will be conducted at three of the seven wells installed. Both drawdown and recovery data will be collected and evaluated.

Slug testing is used to measure the hydraulic conductivity of a formation surrounding a monitoring well. Tests are conducted using a solid slug of known volumetric proportions attached to a specified length of rope to control entry into or out of the water column. The slug test may be conducted one of two methods. The first of which, the slug is introduced into the water column causing the water column to rise then fall to equilibrium (falling head). The second method removes the slug from the water column, once equilibrium has been established the change in the water level measurement is taken as the water rises (rising head).

#### **4.2.2 Temporary Monitoring Well and Piezometer Abandonment**

The typical approach for abandonment (sealing) of the monitoring wells is as follows:

1. Punch out the cap on the bottom of the well.

2. Simultaneously inject or tremie the sealing compound as the monitoring well is extracted. Begin the tremie process at the bottom of the well.
3. In some cases it may be necessary to overdrill the well casing to permit extraction during the tremie process.
4. Fill the well cavity to 2-feet below the ground surface.
5. Allow adequate time for the sealing compound to settle and top of the boring with addition sealant.
6. Restore the ground cover in the position of the well and/or piezometer.

Typical material employed for sealing or abandonment is Portland Type I Cement; one 94 pound bag mixed with approximately 6-8 gallons of water.

#### **4.3 MULTI-MEDIA SAMPLING**

Analytical samples will be collected from representative media including surface and groundwater, surface and subsurface soils, sediments, and IDW in order to quantify potential environmental contamination.

##### **4.3.1 Surface and Subsurface Soil Sampling**

Surface and subsurface soil samples will be collected utilizing a variety of techniques. Surface and subsurface soil sample acquisition from mechanized equipment will use split spoon, macro-core sampler by inserting them into either the borehole or annulus to extract a sample from a desired depth. The sample is removed from the device, scanned with the direct reading instrumentation, then transferred into the appropriate sample container.

Direct Push Technologies uses hydraulic pressure and percussion hammer to advance tooling into the ground. For soil sampling a Macro-core sampler is advanced in 4-foot intervals for soil sample extraction. A disposable tip allows sampling from a discrete depth.

Split spoon samplers are inserted into the hollow stem auger, then driven using a weighted hammer to the desired depth.

Split spoon sampling of subsurface soils will be conducted at NTC Great Lakes and are as follows:

- A preliminary DPT assessment will include approximately 17 soil borings at Site 7.
- Seven of the DPT borings will be converted to temporary monitoring well.

- Vadose zone soil samples exhibiting the highest organic vapor measurements will be submitted for fixed-based laboratory analysis.
- The borings will be installed to a depth of 25 feet with a minimum of one boring to 50 ft. for lithologic purposes.
- Soil cuttings will be drummed at the site and transferred to a staging area at Site 7 for waste characterization sampling.
- Soil samples will also be obtained using a hand auger to sample surface soil.

Split Spoon samples shall be collected in the same manner as described above, if soil recovery using DPT methods procedures an inadequate yield to fill sample containers at Site 7.

#### **4.3.1.1 Hand Augers**

The hand auger borings will be advanced to the desired depth utilizing stainless steel hand auger stems with an over size bucket. Once at the desired depth, the oversize bucket will be exchanged for a smaller diameter bucket to grab the sample. The sample is extracted from the bucket and is placed in a stainless steel bowl, scanned with a direct reading instrument, then transferred into the appropriate glass container using a stainless steel or polyethylene disposable trowel.

#### **4.3.2 Water Level Measurements**

Water levels will be collected from the seven newly installed temporary wells for two rounds. Each round of water level measurements will be used to generate potentiometric surface maps. The water levels will be taken with an electric water level indicator using the top of the well casing as the reference point for determining water depths. Water levels will be conducted upon completion of the newly installed wells. All wells will be allowed to set for 24 hours after installation prior to development and 24 hours after that prior to the one round of water level measurements. The water level measurements will be conducted within the same time interval (same day) to ensure minimal fluctuation.

#### **4.3.3 Monitoring Well Sampling**

The monitoring wells will be sampled using low-flow purging and sampling techniques. Peristaltic pumps will be used to purge and to collect the samples. Field measurements of pH, temperature, specific

conductance, and turbidity will be made during purging. These measurements will be taken at the start of purging and every 5 to 10 minutes until the parameters have stabilized. The wells will be purged until a sufficient predetermined amount of water has been removed and the water quality measurements are acceptable. All tubing used for sampling will be dedicated and disposed of after the sample has been collected.

#### **4.3.4 Surface Water and Sediments**

Surface water and sediment sampling scope for CTO 0154 are as follows:

- Sediment samples will be collected at 44 locations in Pettibone Creek. Sample depths will be for 0 to 4 cm and at 1 foot to support risk assessment needs.
- Sediment samples in Pettibone Creek will be collected using disposable trowels.
- Sediment samples will be collected at 12 locations in the Boat Basin. Sample depths will be for 0 to 4 cm, 4 cm to 3 feet, 3 to 6 feet, and 6 to 10 feet to support risk assessment needs.
- Six surface water samples will be collected from Pettibone Creek and the Boat Basin.

The collection of these environmental media will proceed as follows:

- Selection of location
- Direct-Reading monitoring instrument sweep.
- Transfer the selected environmental media into the containers to be sent to the analytical laboratory using direct pour, peristaltic pumps, or for sediments using stainless steel or disposable trowels.

#### **4.3.5 Investigation Derived Waste Management**

It is estimated that approximately ten drums of IDW will be generated at Site 7 during the investigation. In order to profile the accumulated waste to determine disposal methods and options the following activities will be conducted:

- One composite soil sample and one composite water sample will be collected for characterization.
- Drums will remain on site until the results of the chemical analysis are completed.
- QA/QC samples of the IDW are not required.



- The Navy will sign all waste manifests and Bills of Lading.

Sample collection of liquids and solids will proceed as previously described for those applicable media.

#### **4.4 GEOGRAPHICAL/GEOPHYSICAL SURVEYING**

This activity is generally non-intrusive in nature. As the activity to be conducted is within a developed light industrial area. Surveying activities in support of this scope are as follows:

- The horizontal location and top of casing and ground elevation of each temporary monitoring well will be surveyed.
- The locations will be referenced to site features (building corners, etc.) by a TtNUS subcontracted, state-licensed surveyor.
- The horizontal location and ground elevation for sediment and surface water locations will be surveyed.
- It is assumed that sufficient survey control (vertical and horizontal) is present within 1 mile of the site. It is also assumed as this area is light industrial, site clearing activities for line of site to carry control points will not be necessary.

#### **4.5 DECONTAMINATION**

The equipment involved in the field activities for this investigation will be decontaminated prior to, during and after the sampling activities.

##### **4.5.1 Sampling Equipment**

All non-dedicated sampling equipment (i.e. stainless-steel hand augers, trowels, bowls) will be decontaminated prior to the initiation of field sampling, between sample locations, and at the completion of the field activities. The following decontamination steps will be taken.

- Potable water rinse
- Alconox or Liquinox detergent wash
- Deionized (DI) water rinse

- Solvent rinse (Isopropanol)
- DI water rinse
- Air dry

**All dedicated sampling and PPE equipment will be rinsed to remove gross contamination. Then pending the sampling results be disposed of accordingly.**

The above listing represents a summarization of the tasks as they may apply to the scope and application of this HASP. For more detailed description of the associated tasks, refer to the Sampling and Analysis Plan (SAP). Any tasks to be conducted outside of the elements listed here will be considered a change in scope requiring modification of this document. The TOM or a designated representative will submit all requested modifications to this document to the HSM.

## **5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARIZATION**

Table 5-1 of this section serves as the primary portion of the site-specific HASP and identifies the tasks that are to be performed as part of the scope of work. This table will be modified and incorporated into this document as new or additional tasks are performed at the site. The anticipated hazards, recommended control measures, air-monitoring recommendations, required Personal Protective Equipment (PPE), and decontamination measures for each site task are discussed in detail. This table and the associated control measures shall be changed, if the scope of work, contaminants of concern, or other conditions change.

The FOL/SSO will utilize this table as the primary reference for completion of the task-specific Safe Work Permits. The Safe Work Permit is the primary tool for accomplishing safety and health reviews with field personnel prior to the initiation of any tasks. These permits are to be completed by the FOL/SSO and reviewed with all field personnel at the beginning of each day's activities.

### **5.1 GENERAL SAFE WORK PRACTICES**

In addition to the task-specific work practices identified on Table 5-1, the following general safe work practices (SWP) are to be employed when conducting work on-site. These SWPs establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations. This list is not inclusive and may be amended as necessary.

- Do not eat, drink, chew gum or tobacco, take medication, and/or smoke in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible, if excessive skin contamination occurs.
- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on equipment. Do not place monitoring equipment on potentially contaminated surfaces.
- Be familiar with, knowledgeable of, and adhere to all instructions in the site-specific HASP.

- Be aware of the location of the nearest telephone and all emergency telephone numbers. See Section 2.0, Table 2-1.
- Attend briefings on anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes. See Section 2.0.
- Rehearse unfamiliar operations, prior to implementation.
- Use the "buddy system".
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity to assist each other in case of emergency.
- Establish appropriate Safety Zones including Support, Contamination Reduction, and Exclusion Zones.
- Minimize the number of personnel and equipment in contaminated areas (such as the Exclusion Zone). Non-essential vehicles and equipment should remain within the Support Zone.
- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the Site Safety Officer (SSO).
- Matches and lighters are restricted from entering in the Exclusion Zone or Contamination Reduction Zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

## **5.2 HOLLOW STEM AUGER DRILLING DIRECT PUSH TECHNOLOGIES SAFE WORK PRACTICES**

The following Safe Work Practices are to be followed when working in or around Hollow Stem Auger Drill Rigs Direct Push Rig Operations.

### **5.2.1 Before Drilling**

- Identify all underground utilities and buried structures before drilling. Use the Utility Locating and Excavation Clearance Standard Operating Procedure provided in Attachment II.
- All drill/direct push rigs will be inspected by a Competent Person (the SSO or designee), prior to the acceptance of the equipment at the site and prior to the use of the equipment. All repairs or deficiencies identified will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist provided in Attachment III. Inspection frequencies will be once every 10-day shift or following repairs.
- The work area around the point of operation will be graded to the extent possible to remove any trip hazards near or surrounding rotating or percussion equipment.
- The drillers helper will establish an equipment staging and lay-down plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards. Mechanisms to secure heavy objects such as auger flights, Macro-Core Samplers, and drive rods will be provided to avoid the collapse of stacked equipment.
- All potentially contaminated tooling will be wrapped in polyethylene sheeting for storage and transport to the centrally located decontamination unit.

### **5.2.2 During Drilling**

- Secure frayed or loose clothing, hair, and jewelry when working with rotating equipment.
- Minimize contact to the extent possible with contaminated tooling and environmental media.
- Support functions (sampling and screening stations) will be maintained a minimum distance from the drill/direct push rig. This distance is typically the height of the mast plus five feet or a minimum of

25-feet, whichever is greater, to remove personnel involved in these activities from within physical hazard boundaries.

- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the drill/direct push rig.
- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should move heavy tooling, as applicable and necessary.
- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone. Site visitors will be escorted at all times.

### **5.2.3      After Drilling**

- All equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the SSO to determined cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.
- All motorized equipment will be fueled prior to the commencement of the day's activities. During fueling operations all equipment will be shutdown and bonded to the fuel provider.
- When not in use all drill/direct push rigs will be shutdown, emergency brakes set, and wheels chocked.
- All areas subjected to subsurface investigative methods will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be removed these areas will be barricaded to minimize the impact on field crews working in the area.

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment (Items in <i>italics&gt; are deemed optional as conditions or the FOL or SSO dictate.)</i>	Decontamination Procedures
<p>Decontamination of Sampling and Heavy Equipment</p> <p>It is anticipated that this activity will take place at a centralized location. Gross contamination will be removed to the extent possible at the site. Contaminated tooling then will be wrapped in polyethylene sheeting for transport to the centralized location for a full decontamination and evaluation.</p>	<p><b>Chemical hazards:</b></p> <p>1) Soils – Surface/Subsurface soils, groundwater, and surface water – concentrations are anticipated to be negligible. See Section 6.1 for information concerning the general contaminant groups anticipated.</p> <p>2) Decontamination fluids - Liquinox (detergent); isopropanol (decontamination solvent)</p> <p><b>Physical hazards:</b></p> <p>3) Lifting (strain/muscle pulls) 4) Noise in excess of 85 dBA 5) Flying projectiles 6) Falling hazards 7) Slips, trips, and falls</p> <p><b>Natural hazards:</b></p> <p>8) Inclement weather</p>	<p>1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Control potential non-occupational exposures through good work hygiene practices (i.e., avoid hand to mouth contact; wash hands and face before breaks and lunch; minimize contact with contaminated media). Obtain manufacturer's MSDS for any decontamination fluids used on-site. Solvents may only be used in well-ventilated areas, such as outdoors. Use appropriate PPE as identified on MSDS or within this HASP. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication Program provided in Section 5.0 of the TtNUS Health and Safety Guidance Manual.</p> <p>3) Use multiple persons where necessary for lifting and handling heavy equipment for decontamination purposes.</p> <p>- Employ proper lifting techniques as described in Table 5-1, Mobilization/Demobilization.</p> <p>4) Wear hearing protection when operating the pressure washer and/or steam cleaner. Sound pressure levels measured during the operation of similar pieces of equipment indicate a range of 87 to 93 dBA.</p> <p>5) Use eye and face protective equipment when operating the pressure washer and/or steam cleaner, due to flying projectiles. All other personnel must be restricted from the area. In addition to minimize hazards (flying projectiles, water lacerations and burns) associated with this operation, the following controls will be implemented</p> <p>- A Fan Tip 25° or greater will be used on pressurized systems over 3,000 psi. This will reduce the possibility of water lacerations or punctures.</p> <p>- Thermostat control will be in place and operational to control the temperature levels of the water where applicable.</p> <p>- Visual evaluations of hoses and fittings for structural defects</p> <p>- Construct deflection screens as necessary to control overspray and to guard against dispersion of contaminants driven off by the spray.</p> <p>6) Insure wash and drying racks are of suitable construction to prevent heavier items such as push rod flights from falling during the decontamination process.</p> <p>7) The decontamination pad should be constructed to contain wash waters generated during decontamination procedures. Temporary decontamination pads are usually 10-30 mil polyethylene or polyvinyl chloride tarp construction. Although these items when used as a liner offer containment, they also present a slipping hazard. When these temporary liners are employed, it is recommended that a light coating of sand be spread over the walking surface to provide traction.</p> <p>- In addition, adequate slope should be provided to the pad to permit drainage away from the object being cleaned. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks.</p> <p>- Hoses should be gathered when not in use to eliminate potential tripping hazards.</p> <p>8) Suspend or terminate operations until directed otherwise by SSO.</p>	<p>Use visual observation and real-time monitoring instrumentation to ensure all equipment has been properly cleaned of contamination and dried.</p> <p>Monitoring instrumentation will be employed to determine if all of the decontamination solvent (isopropanol) has been removed through the rinse process. Any positive indication/results greater than background require the article that has been decontaminated to be re-rinsed and scanned again. If necessary this process should be repeated until no measurable indication of the decontamination solvent exists.</p>	<p><b>For Heavy Equipment</b> This applies to pressure washing and/or steam cleaning operations and soap/water wash and rinse procedures.</p> <p>Level D Minimum requirements:</p> <ul style="list-style-type: none"><li>- Standard field attire (Long sleeve shirt; long pants)</li><li>- Safety shoes (Steel toe/shank)</li><li>- Chemical resistant boot covers</li><li>- Nitrile outer gloves over nitrile inner gloves</li><li>- Safety glasses underneath a splash shield</li><li>- Hearing protection (plugs or muffs)</li><li>- Hooded PVC Rainsuits or PE or PVC coated Tyvek. Impermeable aprons may be used instead of coveralls if they offer adequate protection against overspray and back splash.</li></ul> <p><b>For sampling equipment</b> (trowels, bailers, etc.), the following PPE is required</p> <p><b>Note:</b> Consult MSDS for PPE guidance for decontamination fluids/solvents. Otherwise, observe the following.</p> <p>Level D Minimum requirements -</p> <ul style="list-style-type: none"><li>- Standard field attire (Long sleeve shirt; long pants)</li><li>- Safety shoes (Steel toe/shank)</li><li>- Nitrile outer gloves over nitrile inner gloves</li><li>- Safety glasses</li><li>- Impermeable apron</li></ul> <p>In the event of overspray of chemical decontamination fluids, employ PVC Rainsuits or PE or PVC coated Tyvek as necessary.</p> <p><b>Note:</b> The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.</p>	<p><b>Personnel Decontamination</b> will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable).</p> <p>The sequential procedure is as follows:</p> <p>Stage 1: Equipment drop, remove outer protective wrapping; personnel will wipe down the outer shell and pass hand equipment through as necessary. Stage 2: Soap/water wash and rinse of outer boots and gloves Stage 3: Soap/water wash and rinse of the outer splash suit, as applicable Stage 4: Disposable PPE and equipment will be removed and bagged. Stage 5: Wash face and hands</p> <p><b>Equipment Decontamination</b> - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner or pressure washer. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires cleaned/sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the on-site activity.</p> <p><b>Sampling Equipment Decontamination</b></p> <p>Sampling equipment will be decontaminated as per the requirements indicated within the Work Plan.</p> <p>All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site.</p> <p>The FOL or the SSO will be responsible for evaluating equipment arriving on-site, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.</p>

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment (Items in <i>italics&gt; are deemed optional as conditions or the FOL or SSO dictate.)</i>	Decontamination Procedures
<p>Hollow Stem Auger and Direct Push Drilling Operations including:</p> <ul style="list-style-type: none"><li>- Soil borings</li><li>- Monitoring Well Installations</li></ul> <p>DPT - This activity employs hydraulic pressure and percussion hammer to advance tooling into the ground.</p> <p>This activity is planned for the following locations:</p> <ul style="list-style-type: none"><li>- Soil borings - 17 at Site 7</li><li>- Monitoring Well Installations - 7 to be installed at Site 7</li><li>- 12 Sediment borings at Site 17</li></ul> <p>This activity will also include the well and piezometer abandonment activity.</p>	<p><b>Chemical hazards:</b></p> <p>1) Previous analytical data available for the work areas did not identify contaminants in sufficient concentrations to establish occupational exposure threat. General categories of site contaminants include:</p> <ul style="list-style-type: none"><li>- PAHs</li><li>- Metals</li><li>- Pesticides/PCBs</li></ul> <p>Further information on these categories of contaminants are provided in Section 6.1.</p> <p>2) Transfer of contamination into clean areas or onto persons</p> <p><b>Physical hazards:</b></p> <p>3) Heavy equipment hazards (pinch/compressions points, rotating equipment, hydraulic lines, etc.)</p> <p>4) Noise in excess of 85 dBA</p> <p>5) Energized systems (contact with underground or overhead utilities)</p> <p>6) Lifting (strain/muscle pulls)</p> <p>7) Slips, trips, and falls</p> <p>8) Cuts and lacerations</p> <p>9) Vehicular and foot traffic</p> <p>Further information on these physical hazards, see Section 6.2 for further discussions.</p> <p><b>Natural hazards:</b></p> <p>10) Inclement weather</p>	<p><b>Chemical hazards:</b></p> <p>Many of the contaminants as associated with Site 7 have not been thoroughly identified as this site is going through its initial investigation as it pertains to certain media. Safe work practices will be employed as the first line of defense. As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) will be employed as a universal control measure.</p> <p><b>Particulates/Liquids with an Elevated Boiling Temperature</b> -As some of the materials in question are solids (i.e., naphthalenic distillates (PAHs), metals, pesticides/PCBs) and/or bound to particulates, the next control measure to be employed to minimize potential exposure will be good work and personal hygiene practices. These control measures including avoiding hand-to-mouth contact to the extent possible, washing hands and face or using hygienic wipes to remove potential contaminants from hands and face prior to breaks or lunch or other hand to mouth activities will restrict the most predominant route of exposure. Dust suppression methods including area wetting will be employed to control mechanically generated dust emissions.</p> <p><b>Liquids/gases</b> - In situations where contaminants exist in soils or liquid media and present a vapor or gas hazard threat, real time monitoring instruments and PPE will be employed to support protective measures. As part of the evaluation method, all samples will be scanned with a PID to determined potential source concentrations.</p> <p>2) <b>Transfer of Contamination into Clean Areas or onto Persons</b> - Restrict the cross use of equipment and supplies between locations and activities without first going through a suitable decontamination. Work practices including:</p> <ul style="list-style-type: none"><li>- A rigid decontamination procedure will be employed for all equipment between locations and between clean and potentially dirty work. This provision along with dedicated sampling equipment will insure materials are not carried and deposited in unaffected areas.</li></ul> <p><b>Physical hazards:</b></p> <p>3) <b>Heavy Equipment Hazards</b> - All equipment will be:</p> <ul style="list-style-type: none"><li>- Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600.601.602), and manufacturer's design, as applicable. All inspections will be documented using the Equipment Inspection Checklist found in (See Attachment III) of this HASP.</li><li>- Operated and supported by certified operators and knowledgeable ground crew.</li><li>- Used within safe work zones, with routes of approach clearly demarcated. All personnel not directly supporting this operation will remain at least 25 feet from the point of operation. See Section 9.0 of this HASP. This will be the area identified as the exclusion zone.</li><li>- All self-propelled equipment shall be equipped with movement warning systems.</li><li>- All personnel will be instructed in the location and operations of the emergency shut-off device(s). This device will be tested initially (and then periodically) to ensure its operational status.</li><li>- Areas will be inspected prior to the movement of the direct push rig and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO.</li><li>- The direct push, drill rigs, and support vehicles will be moved no closer than 5-feet to unsupported side-walls of excavations and embankments.</li><li>- See additional safe work procedures for drilling in Section 5.2 of this HASP.</li></ul> <p>4) <b>Noise in Excess of 85 dBA</b> - Hearing protection will be used during all subsurface activities using the HSA drill and direct push rig or when noise levels are &gt;85 dBA. (during operation). Previous accumulated data indicates an average 8 hour exposure working behind a direct push rig during hydraulic and hammer advancement of the tooling is approximately 90-102 dBA. The HSA Drill rig averaged 89-96dBA. Controlling this hazard shall be accomplished employing two separate approaches as follows:</p> <ul style="list-style-type: none"><li>- Boundaries will be established to limit the affect of the noise hazard. Typically, the height of the mast + 5 feet or a minimum of 25 feet is normal for DPT rigs, and the height of the mast plus 5-feet is suitable for the HSA Drill Rig.</li><li>- Hearing protection</li></ul> <p>Excessive noise levels (&gt;80dBA) are being approach when you have to raise your voice to talk to someone within 2 feet of your location.</p> <p>5) <b>Energized Systems</b> - All drilling activities will proceed in accordance with the Utility Locating and Excavation Clearance SOP in Attachment II of this HASP. All utility clearances will be obtained, in writing, and locations identified and marked, prior to activities. If it is not obtainable/unknown or the location infringes within 3-feet of an underground utility advancement must proceed by hand until past the utility. The hand dug hole should represent the same diameter of the mechanized tooling that will enter the subsurface media.</p> <p>6) <b>Lifting Hazards</b> - Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques as described in mobilization/demobilization.</p> <p>7) <b>Slips, Trips, and Falls</b> - Preview work locations for unstable/uneven terrain.</p> <ul style="list-style-type: none"><li>- Cover, guard and barricade all open pits, ditches, and floor opening as necessary.</li><li>- Ruts, roots, tools, and other tripping hazards should be eliminated approaching points of operation to minimize trips and falls when approaching operating equipment.</li><li>- Maintain a clutter free work area.</li><li>- As part of site control efforts construct fences or other means of demarcation (i.e. signs and postings) to control and isolate traffic in the work area. Means of demarcation shall also be constructed isolating resource and/or staging areas.</li></ul> <p>8) <b>Cuts and Lacerations</b> - To prevent cuts and lacerations associated with extracting samples from the acetate liners of the Macro-Core Sampling System , the following provisions are required:</p> <ul style="list-style-type: none"><li>- Obtain and use the knife and acetate tube retention tub recommended by Geoprobe to prevent accidents of this nature. These items have been engineered to allow sample acquisition without putting the sampler at risk.</li><li>- Always cut away from yourself and others, then, if a knife slips, you will not impale yourself or others.</li><li>- Do not place items to be cut in your hand or on your knee.</li><li>- Change out blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.</li></ul> <p>9) <b>Vehicular and Foot Traffic Hazards</b> - Use traffic-warning signs, flag persons, and high visibility vests as determined by the SSO when working along traffic thoroughfares. In addition, use physical barricades, when working within normal traffic flow patterns/traffic lanes.</p> <p><b>Natural hazards:</b></p> <p>10) <b>Inclement Weather</b> - To minimize hazards of this nature, the following provisions shall be employed:</p> <ul style="list-style-type: none"><li>- Wear appropriate clothing for weather conditions.</li><li>- Provide acceptable shelter and replacement liquids for field crews as relief from excessive ambient temperatures.</li><li>- Under conditions of elevated levels of PPE, periods of acclimatization, excessive ambient temperature extremes, or if you believe someone is suffering from a heat/cold related disorder, it may be necessary to conduct heat/cold stress monitoring.</li><li>- Electrical storms/high winds - Suspend or terminate operations until directed otherwise by SSO.</li></ul> <p>Follow the provisions as specified in Section 4.0 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual regarding the identification and evaluation of heat/cold stress related conditions.</p>	<p>1) Monitoring shall be conducted to as a general screening effort to qualify and quantify estimated source concentrations of site contaminants in support of the prescribed worker protection levels.</p> <p>Monitoring shall be conducted using a Photoionization Detector (PID) with 10.6eV lamp strength.</p> <p>Based on limited information associated with Site 7, the following correction factors will be employed.</p> <ul style="list-style-type: none"><li>- Sites containing waste oils; petroleum products a correction factor of 0.5 will be employed.</li><li>- Site containing more volatile fractions of petroleum and naphthenic distillates including paint thinners, mineral spirits, and other solvents a correction factor of 0.7 will be employed.</li><li>- Dusts/particulates - All dust/particulate concentrations will be maintained to below visual recognition which is estimated at 2 mg/m<sup>3</sup>.</li></ul> <p><b>Action Level for Volatile Emissions</b></p> <p>Action level - 10 ppm in the workers breathing zone for no greater than 10 minutes duration, no more than 4 occurrences in a single day. Action levels of this level will protect personnel from achieving the most conservative TLV/TWA. Concentration in excess of this action level require personnel to stop work and notify PHSO.</p> <p>Monitoring shall be conducted at the prescribed depths as indicated on the boring logs at the source (borehole) and drillers breathing zone. Monitoring shall also be conducted at the samplers location in the same prescribed frequency when handling samples.</p> <p>Noise monitoring will be conducted at the discretion of the PHSO and/or the SSO.</p> <p>Action Level - &gt;85 dBA Participation in the Project Hearing Conservation Program. Hearing protection is required for this operation.</p> <p>Noise level measurements of greater than 105dBA will require the use of combination plugs and muff for noise protection.</p> <p>All sound level measurements and noise dosimetry should proceed in accordance with the project Hearing Conservation Program(See Attachment VI).</p>	<p>All soil boring operations will be initiated in Level D protection, including the following articles:</p> <p>Sampler/Oversight Personnel</p> <ul style="list-style-type: none"><li>- Standard field dress (long pants, sleeved shirts)</li><li>- Steel toe safety shoes or work boots</li><li>- Hard hat(when within 25-feet of the direct push rig)</li><li>- Safety Glasses(when within the established site control boundaries of the drill or direct push rig or when sampling)</li><li>- Nitrile surgeon style inner gloves for sampling</li><li>- Hearing protection(when within established boundaries of an operating direct push and/or drill rig)</li><li>- <i>Impermeable boot covers</i></li><li>- <i>Reflective vest for traffic areas.</i></li></ul> <p><b>Driller and Driller Helper</b></p> <ul style="list-style-type: none"><li>- Standard field attire including sleeved shirt and long pants</li><li>- Safety shoes (Steel toe/shank)</li><li>- Safety glasses</li><li>- Nitrile inner and outer gloves</li><li>- Hearing protection</li><li>- Hard hat</li><li>- Impermeable boot covers</li><li>- Impermeable aprons are recommended for handling MacroCore Samplers and auger flights to prevent soiling work clothes</li></ul> <p>As site conditions may change, the following equipment will be maintained during all on-site activities</p> <ul style="list-style-type: none"><li>- Fire Extinguishers</li><li>- First-aid Kit</li><li>- Portable Eyewash. This is required during well/piezometer abandonment due to the caustic nature of the Portland Cement.</li></ul> <p><b>Note:</b> The Safe Work Permit(s) for this task (See Attachment IV of this HASP) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.</p>	<p><b>Personnel Decontamination</b> will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, impermeable apron, as applicable</p> <p>Gross contamination of outer boots and outer gloves will be removed at a satellite location near the operation. Final wash and rinse will take place at the centralized decontamination pad.</p> <p>The sequential procedure is as follows:</p> <p>Stage 1: Equipment drop, remove any outer protective wrapping; Decontamination personnel will wipe down the outer shells and pass hand equipment through as necessary.</p> <p>Stage 2: Soap/water wash and rinse of outer boots and gloves</p> <p>Stage 3: Soap/water wash and rinse of the or impermeable apron, as applicable.</p> <p>Stage 4: Disposable PPE will be removed and bagged.</p> <p>Stage 5: Wash face and hands</p> <p>Note: For remote locations away from the centralized decontamination unit</p> <ul style="list-style-type: none"><li>- Bag and/or wrap all disposable and reusable equipment, respectively for transport back to the decontamination unit.</li><li>- Hygienic wipes may be used for cleaning hands and face</li></ul> <p><b>Equipment Decontamination</b> - All heavy and sampling equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner or pressure washer as prescribed in Table 5-1 for that task. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones. Vehicles will have their wheels/tires cleaned or sprayed off as applicable as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity.</p> <p>The FOL or the SSO will be responsible for evaluating equipment arriving on-site, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.</p>



Task/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type And Action Levels	Personal Protective Equipment (Items in Italic Are Deemed Optional As Conditions Or The FOL Or The SSO Dictate.)	Decontamination Procedures
<p>IDW Management and Handling</p> <p>This activity includes the following tasks:</p> <ul style="list-style-type: none"><li>- Containerization</li><li>- Labeling</li><li>- Staging</li><li>- Monitoring</li></ul> <p>of IDW generated in support of site activities.</p>	<p><b>Chemical hazards:</b> The only anticipated hazard associated with IDW management is the potential for a spill. In situations such as that the spill containment program identified in Section 10.0 of this HASP will be employed.</p> <p><b>Physical hazards:</b></p> <ol style="list-style-type: none"><li>1) Strains and sprains</li><li>2) Back injuries</li><li>3) Compressions</li><li>4) Loading bulk transport containers</li></ol>	<p><b>Chemical hazards:</b></p> <p>It is not anticipated that chemical hazards will be significant during this operation, as the IDW will be in sealed containers. However, control measures such as the use of PPE and good work hygiene practices will be used to control potential exposures during the implementation of the Spill Containment Program (See Section 10.0 of this HASP).</p> <p><b>Physical hazards:</b></p> <p><b>1 &amp; 2) Strains and sprains (lifting hazards)/Back Injuries</b> – The predominant hazard associated with this activity is the movement of full or partially full 55-gallon drums of soils and/or water. To minimize hazards of this nature the following provisions shall be incorporated as applicable:</p> <ul style="list-style-type: none"><li>- Use machinery (preferred method) or multiple personnel for heavy lifts.</li><li>- Use proper lifting techniques</li><li>a. Lift with your legs, not your back, bend your knees, move as close to the load as possible, and ensure good hand holds are available.</li><li>b. Minimize the horizontal distance to the center of the lift to your center of gravity.</li><li>c. Minimize turning and twisting when lifting as the lower back is especially vulnerable at this time.</li><li>d. Break lifts into steps if the vertical distance (from the start point to the placement of the lift) is excessive.</li><li>e. Plan your lifts – Place heavy items on shelves between the waist and chest; lighter items on higher shelves.</li><li>f. Periods of high frequency lifts or extended duration lifts should provide sufficient breaks to guard against fatigue and injury.</li></ul> <p>In determining whether you can lift or move an item several factors must be considered, these are as follows:</p> <ul style="list-style-type: none"><li>- Area available to maneuver the lift.</li><li>- Area of the lift – Work place clutter, slippery surfaces, rough terrain</li><li>- Overall physical condition</li></ul> <p><b>3) Compressions</b> – Another hazard frequently associated with this task is the compression of hands and fingers when placing the containers on pallets. This typically occurs when rolling and lowering the container in its place. To combat this hazard, the following provision shall be employed:</p> <p>Material handling devices shall be used for moving drums within the satellite storage area. This includes drum dollies with pneumatic tires, drum grapplers, etc. to handle drums of IDW. These pieces of equipment are engineered to allow placement of these containers while removing hands from the point of operation.</p> <p><b>Reminder:</b> The drums you are attempting to move, lift and/or relocate weigh on the average of</p> <ul style="list-style-type: none"><li>- Full 55-gallon container of purge or decontamination waters = 485 lbs. (including the container)</li><li>- Full 55-gallon container of soils (moist) = 687 lbs. (including the container)</li></ul> <p>Satellite Storage Area – Emphasis has been placed on the physical surroundings and how they can influence the potential hazards associated with material handling aspects of this task. To further reduce material handling hazards, support spill containment and control, and sampling when necessary, the IDW storage area should be structured as follows:</p> <ul style="list-style-type: none"><li>- 4-drums to a pallet with retaining ring bolt and label on the outside for easy access/reference.</li><li>- Maintain a minimum of 4-feet between each row of pallets. This is the minimum distance necessary to wheel drums on a drum dolly</li><li>- If the site is not secured, the satellite storage area shall be fenced and signs placed indicating the following:<ol style="list-style-type: none"><li>a. Primary Point of Contact (Preferably someone at the Base, and make sure they know they been identified as the Primary Point of Contact).</li><li>b. Phone Number</li><li>c. Emergency Contact (If different from the Primary)</li></ol></li><li>- Provide a Drum/Container Inventory to the Primary Point of Contact and to Emergency Services, if they deem it necessary. The inventory should contain:<ol style="list-style-type: none"><li>a. Each drum shall be assigned a unique identification number. This number shall be placed on the label and drum shell using a paint marker (Note: Do not paint the number on the lid as these have a tendency to get exchanged from time to time.)</li><li>b. Types of waste materials (Subsurface soils, drill cuttings; purge/development waters, etc.)</li><li>c. Volumes (Full or level associated with the container after completion of the project location)</li><li>d. Where it was derived from (IDW should be separated by Site and media)</li><li>e. Dates (For all filled containers and at the completion of work for that area or Site)</li><li>f. Contact – For more information</li></ol></li></ul> <p>Note: All drums should be labeled with the same information.</p>	<p>None required, unless spill containment provisions are initiated. Then monitoring will proceed as described in the activity associated with the task when the materials were generated such as soil boring or well installation.</p>	<p>Level D - (Minimum Requirements)</p> <ul style="list-style-type: none"><li>- Standard field attire (Sleeved shirt; long pants)</li><li>- Safety shoes (Steel toe/shank)</li><li>- Leather or canvas work gloves</li><li>- <i>Safety glasses (When utilizing cables or slings to move the containers)</i></li><li>- <i>Hardhat (when overhead hazards exists, or identified as a operation requirement)</i></li></ul> <p>PPE changes may be made with the implementation of the Spill Containment Program. This represents the only anticipated modification to this level of protection.</p>	<p>Not required, unless the implementation of the Spill Containment Program is required due to a spill and/or release. At that point the decontamination procedures for those activities such as soil borings and/or well installation will be followed. The reference reflects the tasks conducted when the materials were generated.</p>

Task/Operation and Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring Types and Action Levels	Personal Protective Equipment	Decontamination Procedures
<p>Mobilization and Demobilization</p> <p>This activity includes, but is not limited to:</p> <ul style="list-style-type: none"><li>- Equipment Preparation and Inspection</li><li>- Resource acquisition and unpacking of supplies</li><li>- Site clearance and preparation – Utility clearances, etc.</li><li>- Establish and construct access routes to sample/work locations, where applicable.</li><li>- Construct decontamination and IDW operation and storage facilities, as applicable.</li></ul>	<p><b>Chemical hazards:</b></p> <p>1) The on-site Hazard Communication Program (Section 5.0 TINUS Health and Safety Guidance Manual) will be followed. All chemicals brought onto the site by Tetra Tech NUS and subcontractor personnel will be inventoried with each applicable chemical having an MSDS on site. This effort shall include</p> <p>Accurate Chemical Inventory List (Entries will match chemicals brought on-site, as the names appear on the MSDS and the label) This list, which also includes quantities and storage locations will be maintained in a centralized location and made available upon request.</p> <p>MSDS's will be maintained in a central location, accessible to all personnel.</p> <p>All containers will have labels specifying the following information:</p> <ul style="list-style-type: none"><li>- Chemical Identity (As it appears on the label, MSDS, and Chemical Inventory List)</li><li>- Appropriate Warning (i.e., Eye and skin irritation, flammable, etc.)</li><li>- Manufacturer's Name Address and Phone Number</li></ul> <p>It will be the FOL and/or the SSO's responsibility to insure this is completed.</p> <p><b>Physical hazards:</b></p> <p>2) Lifting (strain/muscle pulls)</p> <p>3) Cuts and lacerations</p> <p>4) Pinches and compressions/Struck by</p> <p>5) Slips, trips, and falls</p> <p>6) Heavy equipment hazards (swinging booms, hydraulic lines, etc.)</p> <p>7) Vehicular and foot traffic</p> <p>8) Water/Mud Hazards</p> <p><b>Natural hazards:</b></p> <p>9) Ambient temperature extremes (heat/cold stress)</p> <p>10) Insect and animal bites and poisonous plants</p> <p>11) Inclement weather</p>	<p><b>Chemical hazards:</b></p> <p>1) All personnel will be required to review the appropriate MSDS's, prior to the use of a specified chemical substance. Information on hazards and PPE will be communicated on the Safe Work Permit for this task. Any specific provisions recommended by the MSDS shall be in place (i.e., eye wash, fire extinguisher, specified PPE, etc.) prior to using the chemical substance.</p> <p><b>Physical hazards:</b></p> <p>2) <b>Lifting Hazards</b> – During mobilization/demobilization personnel are required to handle equipment, supplies, and resources in preparation for site activities. This hazard becomes more predominant in the early morning hours (prior to muscles becoming limber) and later in the day (as a result of fatigue). The following provisions shall be instituted in order to minimize hazards of this nature:</p> <ul style="list-style-type: none"><li>- Use machinery or multiple personnel for heavy lifts.</li><li>- Use proper lifting techniques</li><li>- Lift with your legs, not your back, bend your knees, move as close to the load as possible, and ensure good hand holds are obtainable.</li><li>- Minimize the horizontal distance to the center of the lift to your center of gravity.</li><li>- Minimize turning and twisting when lifting as the lower back is especially vulnerable at this time.</li><li>- Break lifts into steps if the vertical distance (from the start point to the placement of the lift) is excessive.</li><li>- Plan your lifts – Place heavy items on shelves between the waist and chest; lighter items on higher shelves.</li><li>- Periods of high frequency lifts or extended duration lifts should provide sufficient breaks to guard against fatigue and injury.</li></ul> <p>In determining whether you can lift an item several factors must be considered, these are as follows:</p> <p>Maximum weight lifted by a single person should not exceed 70 pounds. Items over 70 pounds or the amount you feel you can confidently lift up to 70 pounds should define the point where assistance in the lift is sought.</p> <p>Other considerations defining lifting hazards</p> <ul style="list-style-type: none"><li>- Area available to maneuver the lift.</li><li>- Area of the lift – Work place clutter, slippery surfaces</li><li>- Your Overall physical condition</li></ul> <p>3) <b>Cuts and lacerations</b> – To prevent cuts and lacerations associated with unpacking or packing equipment and supplies, during site preparation (clearing access routes), the following provisions are required:</p> <ul style="list-style-type: none"><li>- Always cut away from yourself and others, then, if a knife slips, you will not impale yourself or others.</li><li>- Do not place items to be cut in your hand or on your knee.</li><li>- Change out blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.</li></ul> <p>If hand tools (brush hooks, machetes, etc.) are used to gain access to sample locations, the following precautions are recommended:</p> <ul style="list-style-type: none"><li>- Insure handles are of good construction (no cracks, splinters, loose heads/cutting apparatus.</li><li>- Insure all cutting tools are maintained. Blades shall be sharp without knicks and gouges in the blade.</li><li>- All hand tools (brush hooks, machetes, etc.) with cutting blades shall be provided with a sheath to protect individuals when not in use and when carrying these items over rough or slippery terrain.</li><li>- All personnel will maintain a 10-foot perimeter or greater around persons clearing brush and access paths to sample and/or well locations.</li></ul> <p>4) <b>Pinches/Compressions/Struck By</b> - Do not modify tooling without manufacturer's expressed permission.</p> <ul style="list-style-type: none"><li>- Keep any machine guarding in place, avoid moving parts.</li><li>- Use tools or equipment where necessary to avoid placing hands in areas vulnerable to pinch points.</li><li>- Adjust machine guarding as necessary to minimize distance between guards and point of operation.</li><li>- When staging equipment, insure all stacked loads, shelving, are adequately secure to avoid creating a hazard from falling objects.</li></ul> <p>5) <b>Preview work locations for unstable/uneven terrain.</b> It should be noted that this is considered a predominant hazard at NTC Great Lakes as sample acquisition locations associated with Pettibone Creek are over embankments and levy walls.</p> <ul style="list-style-type: none"><li>- Cover, guard and barricade all open pits, ditches, and floor opening, as necessary.</li><li>- As part of site control efforts fences shall be constructed to control and isolate traffic in the work area. Fences shall also be constructed isolating resource or staging areas.</li><li>- The FOL and the SSO during site surveys and site preparation should identify these potential hazards.</li><li>- All activities conducted greater than 6-feet above ground surface shall employ acceptable engineered fall protection (i.e. handrails and platforms) or accepted fall protection harnesses.</li><li>- Ladders should be placed to allow access and egress from steep embankment and levy walls when marking sample locations.</li></ul> <p>6) <b>Heavy Equipment Hazards</b> - All equipment will be</p> <ul style="list-style-type: none"><li>- Inspected in accordance with OSHA and manufacturer's design.</li><li>- All equipment inspection will be documented on a Equipment Inspection Checklist as provided in (See Attachment III).</li><li>- Operated by knowledgeable operators and ground crew.</li></ul> <p>7) <b>Vehicular and Foot Traffic Hazards</b> - As part of site preparation activities and zone construction, when preparing traffic and equipment considerations are to include the following:</p> <ul style="list-style-type: none"><li>- Establish safe zones of approach (i.e. Boom or mast + 5 feet).</li><li>- Foot and vehicular traffic routes shall be well defined.</li><li>- Heavy equipment patterns shall be isolated using fences or other suitable barricades from pedestrian pathways.</li><li>- Bumpers or other suitable traffic stops shall be placed in areas where it is desired that traffic approaching an open excavation/embankment/levy wall stops.</li><li>- All self-propelled equipment shall be equipped with movement warning systems.</li><li>- The FOL and/or the SSO as a precautionary measure to remove or demarcate physical hazards shall preview traffic routes (foot and vehicular) before the commitment of personnel and resources.</li></ul> <p>8) <b>Water/Mud Hazards</b> – As part of site preparation, sample locations along Pettibone Creek and the Boat Basin will require marking, mapping, and removal/barricading of physical hazards, as well as, securing access. This will bring persons along the water ways, areas of soft footing and mud. To minimize these obvious hazards</p> <ul style="list-style-type: none"><li>- On a Boat - All personnel shall wear Type III personal flotation devices in the event someone falls overboard, boats sinks or capsizes. Type IIIs were selected as they offer the most flexibility for working while still meeting minimum requirements for bouyancy. In situations where personal flotation devices cannot be worn due to the task to be conducted, Type IV Throwable flotation devices shall be immediately available/accessible.</li><li>- Near Waters Edge -When work activities take personnel within four feet of navigable waters edge and over soft footing (Mud/bog areas) personnel will have immediately accessible a lifeline with a throwing bag or Type IV flotation device facilitate extraction from the water or mud. All personnel working on waters edge and bog areas will do so using the buddy system to assist in rescue efforts, if needed. Where necessary work platforms can be laid down to provide a larger surface area of support in muddy/bog areas.</li></ul> <p><b>Natural hazards:</b></p> <p>9) <b>Ambient Temperature Extremes</b> - Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat and cold stress is provided in Section 4.0 of the TINUS Health and Safety Guidance Manual.</p> <p>10) <b>Insect/Animal Bites and Stings and Poisonous Plants</b> - To combat the potential impact of natural hazards, the following actions are recommended</p> <ul style="list-style-type: none"><li>- Avoid nesting – Preview routes, avoid nests, if at all possible.</li><li>- Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control.</li><li>- Tape pant legs to work boots to block direct access. This is especially critical when clearing brush areas to gain access to sample locations.</li><li>- Use repellents – Permethane should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars.</li><li>- Report potential hazards to the SSO.</li><li>- As this activity may take personnel into areas of heavier vegetation, personnel should be cognizant of poison ivy, poison oak, and poison sumac in the area. See Section 6.3 for descriptions of these plants. Protective measures to be used to minimize hazards of this nature</li></ul> <p>a) Avoid direct contact through the use of Tyvek coveralls, clothing, or barrier creams</p> <p>b) Wash after contact with cool water and mild soap.</p> <p>c) Wash equipment contaminated with the oils of these plants to avoid cross contamination.</p> <p>11) <b>Inclement Weather</b> - Suspend or terminate operations until directed otherwise by SSO.</p> <p>See Section 4.0 of the TINUS Health and Safety Guidance Manual for additional information concerning natural hazards.</p>	<p>Visual observation of work practices by the FOL and/or the SSO to minimize potential physical hazards (i.e., improper lifting, unsecured loads, cutting practices, etc.). Monitoring for chemical hazards are not required during this activity.</p>	<p><i>(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)</i></p> <p>Level D - (Minimum Requirements)</p> <ul style="list-style-type: none"><li>- Standard field attire (Sleeved shirt; long pants)</li><li>- Safety shoes (Steel toe/shank)</li><li>- Safety glasses</li><li>- Hardhat (when overhead hazards exists, or identified as a operation requirement)</li><li>- Reflective vest for high traffic areas</li><li>- Hearing protection for high noise areas (At the direction of the FOL and/or the SSO).</li><li>- Flotation Devices when near waters edge/muddy/bog areas</li></ul> <p>As site conditions may change, the following equipment will be maintained during all on-site activities as prescribed in Section 2.0 of this HASP</p> <ul style="list-style-type: none"><li>- Fire Extinguishers</li><li>- First-aid kit</li></ul> <p><b>Note:</b> The FOL and/or the SSO will determine the number of fire extinguishers and first-aid kits to be made available based on the number of operations to be conducted at any given time.</p>	<p>Not required.</p> <p>Good personal hygiene practices should be employed prior to lunch breaks or other periods when hand to mouth contact occurs. This will minimize potential ingestion exposures.</p> <p>Site Preparation – A structured decontamination is not required for this activity. However, as some site preparation activities may require personnel to enter unimproved areas (heavy underbrush wooded areas) personnel should inspect themselves and one another for the presence of ticks when exiting wooded areas, grassy fields, etc. This action will be employed to assist in stopping the transfer of these insects into vehicles, homes, and offices.</p>

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment (Items in Italics are deemed optional as conditions or the FOL or SSO dictate.)	Decontamination Procedures
<p>Multi-media sampling, including</p> <ul style="list-style-type: none"><li>- Surface water – direct pour or pump</li><li>- Ground water – Peristaltic</li><li>- Surface soils and sediments – Trowel</li><li>- Subsurface soils – hand auger, soil corers, and mechanized support (See Soil boring Table 5-1).</li><li>- IDW – Trowel, soil corer, or pump.</li></ul> <p>Protective measures as recommended here shall also apply to aquifer development and hydraulic conductivity testing.</p>	<p><b>Chemical hazards:</b></p> <p>1) Previous analytical data available for the work areas did not identify contaminants in sufficient concentrations to establish a significant occupational threat. General categories include</p> <ul style="list-style-type: none"><li>- PAHs</li><li>- Metals</li><li>- Pesticides/PCBs</li></ul> <p>Further information on these categories of contaminants are provided in Section 6.1.</p> <p>2) Transfer of contamination into clean areas.</p> <p><b>Physical hazards:</b></p> <p>3) Slip, trip, and fall hazards</p> <p>4) Strain/muscle pulls from manual lifting</p> <p>5) Cuts and Lacerations</p> <p>6) Ambient temperature extremes (heat/cold stress)</p> <p>7) Site Characterization</p> <p><b>Natural hazards:</b></p> <p>8) Animal and insect bites and encounters</p> <p>9) Inclement weather</p> <p>10) Water/Mud Bog hazards</p>	<p><b>Chemical hazards:</b></p> <p>1) Many of the contaminants as associated with Site 7 have not been thoroughly identified as this site is going through its initial investigation as it pertains to certain media. Safe work practices will be employed as the first line of defense. As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) will be employed as a universal control measure.</p> <p><b>Particulates/Liquids with a Elevated Boiling Temperature</b> -As some of the materials in question are solids (i.e., naphthalenic distillates (PAHs), metals, pesticides/PCBs) and/or bound to particulates, the next control measure to be employed to minimize potential exposure will be good work and personal hygiene practices. These control measures including avoiding hand-to-mouth contact to the extent possible, washing hands and face or using hygienic wipes to remove potential contaminants from hands and face prior to breaks or lunch or other hand to mouth activities will restrict the most predominant route of exposure. Dust suppression methods including area wetting will be employed to control mechanically generated dust emissions.</p> <p><b>Liquids/gases</b> – In situations where contaminants exist in soils or liquid media and present a vapor or gas hazard threat, real time monitoring instruments and PPE will be employed to support protective measures. As part of the evaluation method of these subsurface media, all samples will be scanned with a PID to determined potential source concentration.</p> <p>2) <b>Transfer of Contamination into Clean Areas</b> - Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. See decontamination of heavy and sampling equipment for direction in this task.</p> <p>3) <b>Slip, Trip, and Fall Hazards</b> – These hazards shall be minimized by adherence to the practices listed below. This includes</p> <ul style="list-style-type: none"><li>- Maintain proper housekeeping in all work areas.</li><li>- Preview and inspect work areas to identify and eliminate slip, trip, or fall hazards.</li><li>- Cover, guard, barricade, and or place warning postings over/at holes or openings that personnel may fall or step into.</li><li>- For traversing steep, slippery, or sloped terrain establish rope ladders to control ascent and descent to sampling areas or use alternative pathways.</li><li>- Regular Ladders should be placed to allow access and egress from steep embankment and levy walls when collecting samples along Pettibone Creek and the Boat Basin.</li><li>- Use multiple persons and pack small loads to remote locations.</li></ul> <p>4) <b>Strain/Muscle Pulls from Manual Lifting</b> - Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques (See Lifting Mobilization/Demobilization, Page 1 of 6, Table 5-1).</p> <p>5) <b>Cuts and Lacerations</b> – Employ the following measures to reduce and/or eliminate the potential for cuts and lacerations</p> <ul style="list-style-type: none"><li>- Obtain and use the knife and acetate tube retention tub recommended by Geoprobe to prevent potential cuts and lacerations when accessing samples within MacroCore and Dual Tube Sampling System acetate liners. These items have been engineered to allow sample acquisition without putting the sampler at risk.</li><li>- Select and secure the most favorable route to monitoring wells and sampling locations.</li><li>- Previewing pathways - Where possible, remove or demarcate the physical hazards.</li><li>- Inspect all cutting equipment to be used to clear access routes for defects.</li><li>- When cutting items - always use a sharp knife and always cut away from your body. Do not place items to be cut in your opposite hand or on your knee.</li><li>- Carry all glassware and items that present a potential for cuts, lacerations, or impalement such as machetes or brush hooks in protective packaging or sheathed to avoid breakage or exposure in the event of a slip, trip, and/or fall.</li></ul> <p>6) <b>Ambient Temperature Extremes (Heat/Cold Stress)</b> - Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress is provided in Section 4.0 of the Health and Safety Guidance Manual.</p> <p>7) <b>Site Characterization</b> - Work areas will be surveyed prior to committing personnel or resources. The survey will be conducted by the FOL and/or the SSO. The purpose is to identify physical and natural hazards that may impact the proposed work area. These hazards are to be identified, barricaded, or eliminated to the extent possible to minimize potential effect to field crew.</p> <p>8) <b>Animal and Insect Bites and Encounters</b> - To combat the potential impact of natural hazards, the following actions are recommended:</p> <ul style="list-style-type: none"><li>- Avoid nesting – Preview routes, avoid nests, if at all possible.</li><li>- Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control.</li><li>- Tape pant legs to work boots to block direct access.</li><li>- Use repellents – Permethrin should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars.</li><li>- Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin.</li><li>- If working in snake infested areas personnel are directed to adhere to the following provisions:<ul style="list-style-type: none"><li>a. Leave snakes and animals alone, do not harass or try to capture. Contact the SSO for direction in the removal of animals and snakes within the confines of the work site.</li><li>b. Snake chaps or high leather boots should be worn in unimproved or unmaintained areas on an initial sweep of the area, if you are unknowledgeable regarding nesting and habitat considerations for indigenous animals and reptiles.</li><li>c. Keep hands and feet out of areas you cannot see. Exercise extreme care when lifting materials or debris providing ground cover as snakes and other animals prefer these areas to nest.</li><li>d. Be cautious when moving debris or other structures, that may serve as a nest. Do not use your hands to separate debris piles. Use equipment (hand tools or heavy equipment, as available).</li></ul></li><li>- As this activity may take personnel into areas of heavier vegetation, samplers should be cognizant of poison ivy, poison oak, and poison sumac in the area. See Section 6.3.3 for descriptions of these plants. Protective measures to be used to minimize hazards of this nature<ul style="list-style-type: none"><li>a) Avoid direct contact through the use of Tyvek coveralls, clothing, or barrier creams</li><li>b) Wash after contact with cool water and mild soap.</li><li>c) Wash equipment contaminated with the oils of these plants to avoid cross contamination.</li></ul></li></ul> <p>9) Suspend or terminate operations during electrical storms. Return to work when directed by the FOL and/or the SSO.</p> <p>10) <b>Water/Mud Hazards</b> – As part of site preparation, sample locations along Pettibone Creek and the Boat Basin will require marking, mapping, and removal/barricading of physical hazards, as well as, securing access. This will bring persons along the water ways, areas of soft footing and mud. To minimize these obvious hazards</p> <ul style="list-style-type: none"><li>- On a Boat - All personnel shall wear Type III personal flotation devices in the event someone falls overboard, boats sinks or capsizes. Type IIIs were selected as they offer the most flexibility for working while still meeting minimum requirements for bouyancy. In situations where personal flotation devices cannot be worn due to the task to be conducted, Type IV Throwable flotation devices shall be immediately available/accessible.</li></ul> <p><b>near waters edge -when work activities take personnel within four feet of navigable waters edge and over soft footing (mud/bog areas) personnel will have immediately accessible a lifeline with a throwing bag or type iv flotation device facilitate extraction from the water or mud. all personnel working on waters edge and bog areas will do so using the buddy system to assist in rescue efforts, if needed. where necessary work platforms can be laid down to provide a larger surface area of support in muddy/bog areas.</b></p>	<p>1) Monitoring shall be conducted to as a general screening effort to qualify and quantify estimated source concentrations of site contaminants in support of the prescribed worker protection levels.</p> <p>Monitoring shall be conducted using a Photoionization Detector (PID) with 10.6eV lamp strength.</p> <p>Based on limited information associated with Site 7, the following correction factors will be employed.</p> <ul style="list-style-type: none"><li>- Sites containing waste oils; petroleum products a correction factor of 0.5 will be employed.</li><li>- Site containing more volatile fractions of petroleum and naphthenic distillates including paint thinners, mineral spirits, and other solvents a correction factor of 0.7 will be employed.</li><li>- Dusts/particulates – All dust/particulate concentrations will be maintained to below visual recognition which is estimated at 2 mg/m<sup>3</sup>.</li></ul> <p><b>Action Level for Volatile Emissions</b></p> <p>Action level - 10 ppm in the workers breathing zone for no greater than 10 minutes duration, no more than 4 occurrences in a single day. Action levels of this level will protect personnel from achieving the most conservative TLV/TWA.</p> <p>Concentration in excess of this action level require personnel to stop work, notify PHSO.</p> <p>Monitoring shall be conducted at the prescribed depths as indicated on the boring logs at the source (borehole) and drillers breathing zone. Monitoring shall also be conducted at the samplers location to in the same prescribed frequency when handling samples.</p>	<p>Level D protection will be utilized for the following sampling activities</p> <p>Surface water, groundwater, and sediments</p> <p>Sampler/Oversight Personnel</p> <ul style="list-style-type: none"><li>- Standard field dress (long pants, Sleeved shirts)</li><li>- Steel toe safety shoes or work boots</li><li>- Safety Glasses</li><li>- Nitrile surgeon style inner gloves for sampling</li><li>- <i>Impermeable boot covers</i></li><li>- <i>Reflective vest for traffic areas</i></li><li>- <i>Identified flotation devices</i></li></ul> <p>Protective Measures as specified for drilling and soil boring will be employed for all subsurface soil sampling.</p> <p><b>Upgrades to Level C protection are not anticipated.</b></p> <p><b>Note:</b> The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.</p>	<p><b>Personnel Decontamination</b></p> <p>Sampling surface water, groundwater, and sediments, the following provisions will apply (Remote Locations)</p> <ul style="list-style-type: none"><li>- Upon completion of the sampling dedicated trowels, tubing, etc. will be bagged for transport back to the central decontamination area.</li><li>- PPE (gloves) will be removed and also bagged for disposal.</li><li>- Handi-Wipes or similar product will be used to clean hands, prior to moving to the next location.</li></ul> <p><b>Equipment Decontamination</b></p> <p>All equipment used in remote sampling locations will be brought back to the central decontamination area for decontamination and re-use or disposal. Decontamination of equipment (sampling and hand tools) will proceed as indicated in the Work Plan Addendum.</p>



Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type And Action Levels	Personal Protective Equipment (Items In Italics Are Deemed Optional As Conditions Or The FOL Or the SSO Dictate.)	Decontamination Procedures
<p>Surveying – Geographical and Geophysical</p> <p>The locations identified to be surveyed are predominantly located within light industrial improved areas.</p>	<p><b>Chemical hazards:</b></p> <p>Significant exposure to site contaminants is anticipated to be unlikely given the nature of this task.</p> <p><b>Physical hazards:</b></p> <p>1) Slips, trips, and falls</p> <p>2) Struck by</p> <p>3) Ambient temperature extremes (heat/cold stress)</p> <p><b>Natural hazards:</b></p> <p>4) Inclement weather</p> <p>5) Insect/animal bites or stings, poisonous plants, etc.</p> <p>6) Water Hazards - drowning</p>	<p><b>Physical hazards:</b></p> <p>1) Preview work locations and site lines for uneven and unstable terrain. Clear necessary vegetation, establish temporary means for traversing hazardous terrain (i.e., rope ladders, etc.)</p> <p>2) If hand tools (brush hooks, machetes, etc.) are necessary to clear and carry lines and bench marks to the area of operation the following precautions are recommended:</p> <ul style="list-style-type: none"><li>- Insure handles are of good construction (no cracks, splinters, loose heads/cutting apparatus.</li><li>- Insure all cutting tools are maintained. Blades shall be sharp without knicks and gouges in the blade.</li><li>- All hand tools (brush hooks, machetes, etc.) with cutting blades shall be provided with a sheath to protect individuals, when not in use.</li><li>- All personnel will maintain a 10-foot perimeter around persons clearing brush.</li></ul> <p><b>Note:</b> It is not anticipated that trees &gt;2-inch girth will be required to be dropped as part of this operation or that significant amount of clearing will be required. Therefore the use of chainsaws and chippers as well as other motorized equipment will not be addressed.</p> <p>3) Ambient Temperature Extremes (<b>Inclement Weather</b>) – To minimize hazards of this nature, the following provisions shall be employed</p> <ul style="list-style-type: none"><li>- Wear appropriate clothing for weather conditions.</li><li>- Provide acceptable shelter and replacement liquids for field crews as relief from excessive ambient temperatures.</li><li>- Under conditions of elevated temperatures allow for periods of acclimatization.</li></ul> <p><b>Natural hazards:</b></p> <p>4) Suspend or terminate operations until directed otherwise by SSO</p> <p>5) To combat the potential impact of natural hazards, the following actions are recommended</p> <ul style="list-style-type: none"><li>- Avoid nesting – Preview routes, avoid nests if at all possible.</li><li>- Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control.</li><li>- Tape pant legs to work boots to block direct access.</li><li>- Use repellents – Permanone should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars.</li><li>- Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin.</li><li>- If clearing lines in snake infested areas, surveyors are recommended to wear snake chaps, as a precaution.</li><li>- As this activity may take personnel into areas of heavier vegetation, samplers should be cognizant of poison ivy, poison oak, and poison sumac in the area. See Section 6.3 of this HASP for descriptions of these plants. Protective measures to be used to minimize hazards of this nature</li></ul> <p>a) Avoid direct contact through the use of Tyvek coveralls, clothing, or barrier creams</p> <p>b) Wash after contact with cool water and mild soap.</p> <p>c) Wash equipment contaminated with the oils of these plants to avoid cross contamination.</p> <p>See Section 4.0 of the TtNUS Health and Safety Guidance Manual for additional information concerning natural hazards.</p> <p>6) Water/Mud Hazards –All sample locations along Pettibone Creek and the Boat Basin will be required to be surveyed as part of surveying operation. This will bring persons along the water ways, areas of soft footing and mud. To minimize these obvious hazards</p> <ul style="list-style-type: none"><li>- <b>Near waters edge -when work activities take personnel within four feet of navigable waters edge and over soft footing (mud/bog areas) personnel will have immediately accessible a lifeline with a throwing bag or type iv flotation device facilitate extraction from the water or mud. All personnel working on waters edge and bog areas will do so using the buddy system to assist in rescue efforts, if needed. Where necessary work platforms can be laid down to provide a larger surface area of support in muddy/bog areas.</b></li></ul>	<p>Air monitoring is not required given the unlikelihood that airborne contaminants will be present. The potential for exposure to site contaminants during this activity is considered minimal.</p>	<p>Surveying activities shall be performed in Level D protection</p> <p>Level D Protection consists of the following:</p> <ul style="list-style-type: none"><li>- Standard field dress including sleeved shirt and long pants</li><li>- Shoes rugged lug sole for traction</li><li>- Work gloves shall be worn when clearing brush.</li><li>- <i>Safety glasses, hard hats (if working near machinery, overhead hazards, or clearing brush)</i></li><li>- <i>Snake chaps for heavily wooded area where encounters are likely.</i></li><li>- <i>Tyvek coveralls may be worn to provide additional protection against poisonous plants and insects, particularly ticks.</i></li><li>- <i>Reflective or blaze orange vests should be worn when working along traffic thoroughfares.</i></li><li>- <i>Identified flotation devices for work on or near waters edge.</i></li></ul> <p><b>Note:</b> The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.</p>	<p><b>Personnel Decontamination - A</b> structured decontamination is not required as the likelihood of encountering contaminated media is considered remote. However, survey parties should inspect themselves and one another for the presence of ticks when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices. In addition, early detection shall provide for early removal.</p>

## 6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical, physical, and natural hazards associated with the sites to be investigated and the activities that are to be conducted as part of the scope of work. Section 6.1 provides general information regarding predominant contaminants that may be present at the site.

### 6.1 CHEMICAL HAZARDS

The potential health hazards associated with work to be conducted at NTC Great Lakes include inhalation, ingestion, and dermal contact of various contaminants that may be present in shallow and deep soils, sediment, and groundwater. Based on the site histories and prior sampling efforts, the types of contaminants anticipated include petroleum products and associated compounds. The following have been identified as the primary classes of these contaminants, including the specific compound(s) of interest:

- Polynuclear Aromatic Hydrocarbons (PAH's) including
  - Anthracene
  - Fluorene
  - 1-Methylnaphthalene
  - 2-Methylnaphthalene
  - Naphthalene
- Metals including
  - Arsenic
  - Chromium
  - Lead
  - Manganese
  - Mercury
  - Nickel
- Pesticides/PCBs including
  - 4,4'-DDD
  - 4,4'-DDE
  - 4,4'-DDT

- Chlordane
- Dieldrin
- Endrin
- Heptachlor
- Delta-BHC
- Aroclor - 1254

There are several considerations to note, both regarding the types of contamination and the reported concentrations. These are as follows:

It should be noted, that based on analytical data from previous sampling efforts, none of the above reported contaminants present a vapor, gas, or dust inhalation hazard, due to limited source concentrations and proposed site activities.

- PAHs are irritating to the skin and eyes, providing they exist in sufficient concentrations and remain at the site for a sufficient period of time.
- The contaminants indicated above exist in particulate or solid form or can be bound to particulates generated during site activities. This has particular relevance for two reasons. The first of which is that we can see the contamination or visually identify its potential presence in the form of dust and dust clouds. Secondly, using visual detection, we can control exposure by controlling the generation of dust utilizing dust suppression methods such as area wetting. It should be re-emphasized that the previously reported concentrations are not anticipated to present an exposure hazard. It should also be noted that dust is visible at  $2 \text{ mg/m}^3$ , making detection possible well in advance of potential exposure.

General toxicology information associated with these substances are as follows:

### **PAHs**

Substances including acenaphthalene, chrysene, fluoranthene, pyrene, creosote, Benzo(a)pyrene make up the some of the represented PAHs previously detected. Toxic effects due to overexposure include:

Irritating to the skin, eyes and mucous membranes of the respiratory system. This is providing they exist in sufficient concentrations and remain at the site for a sufficient period of time. The toxicity is also relative to the freshness of the compounds. Many of these substances have been exposed to environmental weather

conditions (precipitation, temperature extremes, degradation and breakdown, etc.) for a significant period of time within this drainage channel. Some of these compounds have been identified as suspected cancer causing agents. These of course represent chronic long time exposures, which are not anticipated as part of this scope.

### **Metals**

Substances including arsenic, chromium, lead, manganese, mercury, and nickel represent the metals previously reported.

Typical toxicological responses to these substances through ingestion, which is considered the most prevalent route given the physical state of these substances include:

Ulceration of the mucosal lining of the GI and respiratory tract, sore throat, excessive salivation, potential skin and eye mechanical irritation leading to conjunctivitis and possibly dermatitis. Additional systemic effects may include central nervous system depression including headaches, numbness, possible paralysis, twitching and tremors.

Some of these compounds have been identified as suspected cancer causing agents. These of course represent chronic long time exposures, which are not anticipated as part of this scope.

Much of the toxicological data for these substance and information related to signs and symptoms of exposure have come from studies performed in the metal industry which typically involve exposures via inhalation of fumes rather than ingestion.

### **Pesticides/PCBs**

Substances including 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Chlordane, Dieldrin, Endrin, Heptachlor, Delta-BHC, Aroclor - 1254 represent the Pesticides/PCBs previously reported.

Typical toxicological responses to these substances through ingestion, which is considered the most prevalent route given the physical state of these substances include:

Vomiting, gastric irritation, and diarrhea. Central nervous system effects may also be noted including headaches, numbness, possible paralysis, twitching and tremors. This may be accompanied by confusion,

apprehension, and depression. The PCBs may result in skin irritation, chloroacne, and systemic liver dysfunction and disease.

It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (drilling, soil sampling, etc.). If exposure to these compounds were to occur, it is most likely to occur through ingestion of contaminated soil or water via hand-to-mouth contact. For this reason, PPE and basic hygiene practices (washing face and hands before leaving site) will be extremely important. Inhalation exposure will be avoided by using appropriate PPE and engineering controls where necessary. Significant exposure via inhalation is not anticipated during the planned scope of work.

## **6.2 PHYSICAL HAZARDS**

In addition to the chemical hazards discussed above, the following physical hazards may be present during the performance of the site activities.

- Slips, trips, and falls
- Lifting (strain/muscle pulls)
- Noise in excess of 85 decibels (dBA)
- Heavy equipment hazards (pinch/compression points, rotating equipment, etc.).
- Energized systems (contact with underground or overhead utilities)
- Heat/Cold Stress (Ambient temperature extremes)
- Cuts/Lacerations
- Water hazards

These physical hazards are discussed in Table 5-1 as applicable to each site task. Further, many of these hazards are discussed in detail in Section 4.0 of the Health and Safety Guidance Manual. Specific discussions on some of these hazards are presented below.

### **6.2.1 Slip, Trip and Fall Hazards**

Various potential slip, trip and fall hazards may be encountered during the performance of planned site activities. This is considered a predominant hazard associated with sampling along Pettibone Creek and at the Boat Basin as persons will be moving over and along embankments and supported walls. These hazards are associated with working out doors where uneven or wet terrain may be encountered, or near the edge of bodies of water. To minimize the potential for worker injury from these hazards, the following requirements must be observed:



- Maintain proper housekeeping in all work areas.
- Preview and inspect work areas to identify and eliminate slip, trip, or fall hazards. In outdoor locations, pay particular attention to sink holes or other depressions that may be encountered.
- Any work that is to be done on structures that are more than 6-feet above floor or ground level will require fall protection training and the use of 100% fall protection equipment.
- Cover, guard, barricade, and or place warning postings over/at holes or openings that personnel may fall into or step into.
- The safest approach to sample points will be identified and cleared to permit field crew access to sample locations.
- Establish anchor points and rope handrails for traversing/ascending/descending angles and slopes greater than 45% grade.
- Footwear with an adequate traction.
- Prepare work areas by removing tripping hazards (ruts, roots, debris). This is especially critical around rotating equipment, where a fall into the rotating apparatus could be life threatening.

#### **6.2.2     Strains/Muscle Pulls**

This hazard potential is greatest during mobilization/demobilization activities when most of the physical handling is accomplished. Other activities which present this hazard include handling heavy auger flights and bags of portland cement (~94 pounds).

Worker injuries resulting from improper manual material handling activities are easily prevented through observation of proper lifting and carrying methods. These types of injuries are not limited to merely the factor of the weight of the load. Other considerations include how many lifts will be involved (i.e., repetitive lifting of even small loads), the size, shape, and/or configuration of the load to be lifted, and whether or not the load will need to be lifted to another height or carried to another location. All workers involved with these types of activities are to be instructed by the SSO in the following manner:

- First estimate the weight and configuration of the load (i.e., is it bulky or hard to safely grasp/lift/control). If it appears to be too heavy or bulky to safely handle alone, either use a mechanical lifting device or obtain help from another employee to lift the load (Note: The use of mechanical lifting devices is **always** preferable over manual lifting).
- Bend at the knees (not at the waist) when attempting a lift.
- Ensure that a firm hold is obtained, and keep the load as close to the body as possible.
- Lift the load using your legs, and not the back.
- Avoid turning or twisting while holding a load.
- If the load is to be moved, preview the path of travel first to identify and eliminate any tripping hazards.
- Do not attempt to carry loads that obstruct the line of sight.
- When setting a load down, again use the leg muscles and do not bend at the waist.

### 6.2.3 **Noise in Excess of 85 dBA**

Worker exposure to noise that can approach hazardous levels is a common potential hazard on most project work sites. All workers who must work in areas or who must perform operations where noise levels can approach an 8-hour time weighted average of 85 decibels on the A-weighted scale (dBA) must have received hearing conservation training within the past 12 month period. If personnel have not had this training within the last twelve months they will be provided such training by the SSO at the project site prior to participating in high noise level activities. On this project, high noise levels may be encountered when working near the drill/direct push rigs and during decontamination operations.

As a general rule-of-thumb to prevent worker exposure to high noise levels, workers will be informed to observe the following:

*If ambient noise levels are loud enough that they have to raise their voice in order to communicate with another person who is less than 2 feet away, hearing protection will be required. Also, if any existing base operations are posted as high noise areas or that hearing protection is required in that area, then that protection will be used.*

Site boundaries for exclusion zone demarcation has included sufficient distances to accommodate potential noise hazards associated with the identified operations. This information is provided in Section 9.1.

**6.2.4 Exposure to Pinch or Compression Points and/or Entanglement or Contact With Moving or Rotating Equipment/Machinery**

Moving and operating machinery present potential hazards of entanglement, caught in or between, and/or to be struck by machines or machine parts. Hazards of this nature are considered a predominant hazard associated with drilling operations and is a significant hazard associated with HSA activities. Many of the recorded fatalities within the drilling industry have been associated with entanglement within the spinning augers. The factors associated with this hazard include snag points on the rotating apparatus, as well as, the existence of loose clothing, jewelry and long hair. This hazard is often compounded by inoperable emergency stop devices. Recognition and control shall focus on identification to minimize these risks. The following measures shall be instituted

- All equipment that is to be operated must first be closely inspected to ensure that adequate machine guarding is in place.
- No maintenance or other activities are to be performed on operating machines. Also, employees whose duties places them in proximity to moving machinery items are to avoid wearing jewelry, or have long (unrestricted) hair, or loose fitting clothing.
- Also, the use of home-made or jury-rigged machine parts is strictly prohibited. All equipment parts must be manufacturer provided or approved.

In addition, to further minimize hazards of this nature and as this activity shall take place within a light industrial area, the following additional precautions shall be employed:

**Traffic Patterns in and around the drilling area** – Traffic for heavy equipment and pedestrians shall be separated by flow patterns. All heavy equipment (drill rigs and support vehicles) shall be routed in a singular direction to minimize backing, U-turns, and other maneuvers that could result in an accident. A demarcation area shall be established in plain view, so all personnel recognize the boundary of potential physical hazards. Boundaries established to control hazards of this nature are as follows:

- Hollow-Stem Auger (HSA) Drilling Operation - The height of the mast plus five feet. At this distance non-essential personnel will be removed from the identified impact area of potential physical hazards such as the mast collapsing, cables releasing/breaking, as well as, potential chemical exposure. All personnel not directly supporting this operation shall remain outside of this designated/demarcated area.

- Direct Push Technologies - The height of the mast plus five feet or a minimum distance of 25-feet. At this distance non-essential personnel will be removed from the identified impact area of potential physical hazards such as the mast collapsing, high pressure release from the hydraulic operating system.

The positioning of drill/DPT and support vehicles will be done so utilizing a ground spotter. In situation where our operations impede or impact vehicle and/or pedestrian traffic, flag persons and barriers, as well as, high visibility vests will be employed for visual recognition and control of the work zone.

#### **6.2.5 Contact with Energized Sources, Including Operating Processes and Utilities (Aboveground And Underground)**

Contact with energized sources can result in severe injury and even death. There are two areas of concern with this potential hazard: contact with energized processing equipment and contact with energized utilities including underground utilities (including electrical transmission lines, gas lines, water lines, etc.) and overhead utilities (i.e., power lines).

To protect against the first concern, contact with energized processing equipment, any work on or near these types of items will be required to follow the Company Safe Work Practice on the Control of Hazardous Energy Sources (Lockout/Tag out), SWP number 6-2. This is not included in this HASP, however, should the need arise, it is available to all employees on the intranet at [http://go2.tetrattech.com/Emp\\_docs/hs/vol3/swp6-02\\_Control\\_of\\_Hazardous\\_Energy\\_Sources.doc](http://go2.tetrattech.com/Emp_docs/hs/vol3/swp6-02_Control_of_Hazardous_Energy_Sources.doc).

**Contact with Energized Systems** – Much of the work to be done at NTC Great Lakes are to be conducted within light industrial areas supported by underground and overhead energy sources. Preliminary efforts to control hazards of this nature will include:

- Use and application of Attachment II, Standard Operating Procedure (SOP) for Utility Locating and Excavation Clearance. This procedure provides step by step instructions for clearance of underground utilities, as well as, avoidance techniques, and required documentation.
- Establishing a suitable clearance distance (20-feet) from overhead utilities will be the primary method to control hazards conveyed through contact with these power sources.

Regarding protection from contacting underground or overhead utilities, the procedures and restrictions of the company SOP on Utility Location and Excavation Clearance (see Attachment II) is to be followed

during site operations. This SOP addresses both underground and overhead utilities. This SOP is also available to all employees on the intranet at [http://webmail.nus.tetrattech.com/\\_private/\\_sop/HS-1.0.pdf](http://webmail.nus.tetrattech.com/_private/_sop/HS-1.0.pdf).

### **Utility Locating Procedures**

- 1) Contact Bryan Holtrop regarding points that are to be cleared. Provide necessary drawings. Where possible mark the locations on the ground using white paint.
- 2) Mr. Holtrop will request utility clearance through PWC at (847) 688-2121 Ext. 18 Judy Jarosz.
- 3) 15 Working Days advance notification is required.
- 4) All utility clearances are good for 14 days from the day of issue. In situation where the completion of subsurface activities will not be completed in this time frame, extensions maybe obtained.
- 5) Copies of the ticket and clearance should be obtained prior to the commencement of subsurface activities.

If all else fails and a utility is struck, contact emergency numbers provided in Table 2-1.

### **6.2.6 Heat/Cold Stress**

Given the geographic location of the site, overexposure to ambient temperature extremes (heat/cold stress) may exist during performance of this work depending on the project schedule. Work performed when ambient temperatures exceed 70°F may result in varying levels of heat stress (heat rash, heat cramps, heat exhaustion, and/or heat stroke) depending on variables such as wind speed, humidity, and percent sunshine, as well as physiological factors such as metabolic rate and skin moisture content. Additionally, work load and level of protective equipment will affect the degree of exposure. Site personnel will be encouraged to drink plenty of fluids to replace those lost through perspiration. Fatal exposures to cold stress may also result from accidental exposures to low ambient temperatures as well as immersion into low temperature waters. Pain in the extremities and shivering are first signs of the potential on-set of cold stress. Adequate insulating layers of dry clothing, wind breaks where possible, and work-warm regimen to control the deleterious effects of cold stress.

Each of these physical hazards are discussed in greater detail in Section 4.0 of the TtNUS Health and Safety Guidance Manual. Additionally, information on the associated control measures for these hazards are discussed in Table 5-1 of this HASP.

#### **6.2.7 Cuts/Lacerations**

One of the more predominant hazard associated with direct push operations (soil boring activities) is cutting open the Macro-Core acetate liner to access the soil sample. This activity has resulted in numerous cuts to hands and legs, as persons attempt to slice open the liners, while resting the liner in their opposite hand or on their leg.

To minimize this hazard, it is recommended that the knife system and acetate liner holder developed by Geoprobe be used. These items have been engineered to allow sample acquisition without putting the sampler at risk. In addition, the following safe work practices will assist in the minimization of this hazard:

- Always cut away from yourself and others, then, if a knife slips, you will not impale yourself or others.
- Do not place items to be cut in your hand or on your knee.
- Change out blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.

### **6.3 NATURAL HAZARDS**

As most of the work to be conducted will occur in areas that are improved or maintained, natural hazards are not considered to be significant. It will however, be addressed as some of the areas along the water ways may be nesting areas.

Insect/animal bites and stings, poisonous plants, and inclement weather are natural hazards that may be present given the location of activities to be conducted. In general, avoidance of areas of known infestation or growth will be the preferred exposure control for insects/animals and poisonous plants. Specific discussion on principle hazards of concern follows:

#### **6.3.1 Insect Bites and Stings**

Insect/animal bites and stings maybe difficult to control. At NTC Great Lakes climatic and environmental setting may directly effect populations and levels of infestation. However, in an effort to minimize this hazard the following control measures will be implemented where possible.

- Commercially available bug sprays and repellents will be used whenever possible – Pesticides analytical screening includes chlordane, endrin, lindane, methoxychlor, toxaphene and heptachlor. Commercially available repellants may be used providing they don't contain substances which appear on the analytical list for pesticide analysis. Products such as DEET should not be applied directly to the skin due to potential irritation. This product, when permitted for use, should be applied over clothing articles.
- Where possible, loose-fitting and light-colored clothing with long sleeves should be worn. This will also aid in insect control by providing a barrier between the field person and the insects and to provide easy recognition of crawling insects against the lighter background. Pant legs should be secured to the work-boots using duct tape to prevent access by ticks. Mosquito nets are also recommended for use when commercially available repellents are not permitted.
- Clothing/limited body checks for ticks and other crawling insects should be conducted upon exiting heavily vegetated areas. Workers should perform a more detailed check of themselves when showering in the evening. Ticks prefer moist areas of the body (arm-pits, genitals, etc.) and will migrate to those locations.
- The FOL/SSO will preview all access routes and work areas in an effort to identify physical hazards including nesting areas in and around the work sites. These areas will be flagged and communicated to all site personnel.
- The FOL/SSO must determine if site personnel (through completion of Medical Data Sheets), suffer allergic reactions to bee and other insect stings and bites. Field crew members who are allergic to bites should have their emergency kit containing antihistamine and a preloaded syringe of epinephrine readily available.

Any allergies (insect bites, bee stings, etc.) must be reported on the Medical Data Sheet and to the SSO.

#### **6.3.1.1 Tick and Mosquito Transmitted Illnesses And Diseases**

Ticks and mosquitoes have been identified in the transmission of diseases including Lyme's disease and malaria. Warm months (Spring through early Fall) are the most predominant time for this hazard. Information concerning Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Section 4.0 of the Health and Safety Guidance Manual.

Malaria may occur when a mosquito or other infected insect sucks blood from an infected person, and the insect becomes the carrier to infect other hosts. The parasite reproduces within the mosquito, and is then passed on to another person through the biting action. Acute symptoms include chills accompanied by fever and general flu like symptoms. This generally terminates in a sweating stage. These symptoms may recur every 48 to 72 hours.

### **6.3.2      Snakes and Other Wild Animals**

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may be present at the site. These animals may be encountered if work locations encroach on nesting or territories claimed by these animals.

To avoid the obvious hazards conveyed as part of a direct encounter, the following actions will be taken to minimize impact on the field crews and/or operations. The FOL/SSO will preview access routes and work locations for nesting areas or signs of animal activities (tracks, foraging areas, etc.). All identified suspect areas will be communicated to the field crews. Snake chaps will be required as a precaution in areas potentially inhabited by snakes.

#### **6.3.2.1      Snake Bites**

All initial efforts will be directed to avoid, where possible, nesting and territorial areas. However, should field personnel come in contact with these animals and receive a bite, the following actions are necessary.

- Obtain a detailed description of the snake. This and the bite mark will enable medical personnel administering medical aid to provide prompt and correct antidotes, as necessary. Within southern Illinois predominant species include the Timber Rattle snake, copperhead, cottonmouth, and to a lesser degree the Massasauga Rattle snake. Of these the most predominant along waterways are the copperhead and cottonmouth.
- Immobilize the bite victim to the extent possible. Physical exertion will mobilize the toxins (if poisonous varieties) from the bite point systemically through the body.
- Apply a pressure wrap (for extremities), just above and over the bite area. With a couple wraps of the pressure wrap in place over the bite area, apply a splint, and continue the application of the pressure wrap. The purpose for the splint is to restrict the movement of the extremity, this along with the pressure wrap will aid in restricting the toxins from leaving the site of the bite.



- Seek medical attention immediately.

Although this is not considered a predominant hazard, various species will exit from dens along waterways to sun themselves along rocks and concrete structures. It is during these periods when encounters may occur.

### **6.3.3      Poisonous Plants**

Various plants which can cause allergic reactions may be encountered during field work. These include, poison ivy, poison oak, and poison sumac. Contact with these plants may occur when clearing vegetation for access to work areas, or as a result of movement through these plants. An irritating, allergic reaction can occur after direct contact with the plant or indirect contact through some piece of equipment or clothing article. Oils are transferred from the plant to exposed skin, clothing, or piece of equipment. The degree of the irritating, allergic reaction can vary significantly from one person to the next.

Protective measures to control and minimize the effects of this hazard may include, but not be limited to, the following:

- Identify plants for field personnel.
  - Poison Ivy - Characterized by climbing vines, three leaf configuration ovate to elliptical in shape, deep green leaves with a reddish tint, greenish flowers, and white berries.
  - Poison Sumac - Characterized as a tall bush of the sumac family bearing compound leaves (7-13 entire leaflets), branched from a central axis, drooping, with axillary clusters of white fruit: However, these white fruits and berries may exist only during pubescent stages.
  - Poison oak - Characterized as similar to poison ivy consisting of a shrub, stems erect, 0.3 to 2.0 meters tall, leaflets consist of broad thick lobes coarsely serrated configuration, denser at the base, less so than the top.
- Protective measures may include wearing disposable garments such as Tyvek when clearing brush. These may be carefully removed and disposed of along with any oils accumulated from the plants.

- Personal Hygiene - The oils obtained from the plants will only elicit an allergic response when the person's bare skin layer is contacted. This can be aggravated when skin pores are open (perspiring), or through breaks in the skin such as cuts, nicks, scratches, etc. This can also be accomplished when using excessively hot water for cleaning the skin, which also causes pores to open. Prior to break time, lunchtime, etc. personnel should wash with cool water and soap to remove as much of the oils as possible. In heavily vegetated areas of these plants, additional measures including barrier creams and blocks may be used to prevent the oils from accessing and penetrating the skin.

All of these plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and therefore will not be addressed. Again based on the location, this hazard is not believed to be significant and the above text is provided for informational purposes only.

#### **6.3.4 Inclement Weather**

Project tasks under this Scope of Work will be performed outdoors and near water. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, hurricanes, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

#### **6.4 WATER HAZARDS**

Given the location of this project the potential for working near water exists. To prevent accidents that could occur associated with working near water the following provisions shall apply.

##### **On a Boat**

All personnel shall wear Type III personal flotation devices in the event someone falls overboard, boats sinks or capsizes. Type IIIs were selected as they offer the most flexibility for working while still meeting minimum requirements for buoyancy. In situations where personal flotation devices cannot be worn due to the task to be conducted, the flotation devices shall be immediately available/accessible. It is recommended that personal flotation devices be worn at all times during colder months due to the potential for hypothermia to restrict muscle movement and therefore, self rescue and maintaining buoyancy.

In addition, a single Type IV Throwable Flotation Device shall be maintained on board the boat with at least 90 feet of 3/8 polypropylene line.

### **Near Waters Edge**

When work activities take personnel within four feet of navigable waters edge and in areas where the sediments and silts are soft personnel will have immediately accessible a lifeline with a throwing bag or Type IV flotation device facilitate extraction from the water or mud. All personnel working on waters edge and near soft silts and mud will do so using the buddy system to assist in rescue efforts, if needed.

## **7.0 HAZARD MONITORING**

Direct reading instruments will be used as a general screening device at the site to detect and evaluate the presence of site contaminants and other potentially hazardous conditions.

This section provides direction and protocol for real time air monitoring. The monitoring of hazardous conditions has two primary objectives.

- *Qualify and quantify potential hazards (chemical, physical, and biological) that, may impact the work force or sensitive receptors in the immediate area.*
- Evaluate environmental sampling media, which will be sent off-site.

### **7.1 TASKS TO BE CONDUCTED**

The following tasks are to be conducted as part of the scope of work at NTC Great Lakes. It is hazards associated with these tasks, which may be monitored for the purpose of quantification/ qualification of those hazards.

- Direct Push Technologies (DPT) and drilling activities
- Multi-media Sampling – Surface and subsurface soils; groundwater, sediment
- Decontamination activities

### **7.2 ASSOCIATED HAZARDS**

Hazards associated with these tasks for which monitoring may be used to qualify/quantify, include:

- Noise – Information obtained from previous monitoring efforts indicate excessive noise levels, depending on the type of rig.
  - Monitoring well installation using Hollow Stem Auger Applications – Based on the type of drill rig operate between 89 – 96 dBA.
  - DPT range from 90 to 102 dBA-TWA

- Generators – When generators are used as portable power sources for well development or sampling, the generator should be placed a sufficient distance from the operation to eliminate the noise hazard. The generators emit approximately 82 to 88 dBA.
- Steam Cleaners and pressure washers – Previous data indicate that these machines emit from 94 to 102 dBA.

The decision to proceed with noise monitoring will be at the discretion of the PHSO and the SSO. This decision will be based on the necessity to quantify noise levels associated with a particular type of rig selected to perform the subsurface investigation. In addition noise quantification may be performed to insure the hearing protection devices selected attenuation capabilities are sufficient for those noise levels produced, if noise levels are excessive. All noise monitoring will proceed in accordance with the Hearing Conservation Program provided in Attachment VI.

### **Chemical Hazards**

Chemical hazards (Contaminated environmental media exposure) – Historical information regarding groundwater contamination has been gathered and the maximum positive detection's have been identified. This information has been used to determine potential worker exposure during tasks such as soil boring and groundwater sampling. Under current considerations, it is not anticipated that these contaminants will present a significant exposure threat. The contaminants in question represent maximum detected concentrations and are considered a worst case scenario. The contaminants in question are not readily detected and in some cases, and not detected at all in other cases, such is the case with metals, pesticides/PCBs, and certain PAHs. Since these substances will be present in the solid form and/or bound to particulates, efforts will be directed at the minimization of mechanical dispersion and control of dust clouds. The instrument recommended for use for general screening is a PID with a 10.6 eV lamp strength. Typical relative response ratio/correction factors for naphthalenic distillates average at approximately 40%; aromatics 50% and solvent based substances range from 70-150%.

Given the concentrations available, the media in which they exist, and the instrument sensitivity to the compounds in question, the use of real-time monitoring instrumentation outside of general screening is not practical. It is recommended that the instruments be used as a general screen for possible pockets of contamination that may exist at higher concentrations and are more readily detectable. The Health and Safety Guidance Manual, Section 1.0, contains detailed information regarding direct reading instrumentation, as well as general calibration procedures of various instruments.

### 7.3 INSTRUMENTS TO BE USED FOR HAZARD MONITORING

The following instrument will be used for monitoring the hazards identified above.

#### 7.3.1 Metrosonics dB-307 Noise Dosimeter/or Equivalent

The db-307 is a dual purpose sound level meter and noise dosimeter. The instrument is calibrated in accordance with manufacturers instructions using a 102dBA acoustical calibrator. The instrument is calibrated pre- and post to monitoring activities in accordance with the Hearing Conservation program provided in Attachment VI of this HASP. Information regarding calibration is recorded either on the Noise Dosimetry Log or the Sound Level Measurement Log, relative to the type of monitoring being performed. Use of this instrument is currently based on the discretion of the PHSO and/or the SSO.

#### 7.3.2 Chemical Contaminant Monitoring

Monitoring for airborne chemical contaminants released from environmental media will be performed during the following intrusive activities:

- Soil boring

Chemical air monitoring will be performed by the SSO using a photo-ionization detector (PID) as a primary screening instrument. Instruments will be used primarily to monitor source points and worker breathing zone areas, while observing instrument action levels. Action levels are discussed in Table 5-1 as they may apply to a specific task or location. As was indicated earlier, the relative response ratio/correction factor for the compounds in question that can be detected varies. For example if a substance has a 40% relative response ratio/correction factor. Therefore, results obtained on these instruments should be multiplied by 0.4 to obtain actual values. For example:

$$10 \text{ ppm (instrument reading)} \times 0.4 \text{ (correction factor)} = 4.0 \text{ ppm (adjusted value)}$$

Within the area of Site 7, where solvents may have been disposed of the general correction factor to be employed will be 1.25. This will provide detection and representative concentration for acetone, carbon disulfide, fuels and gasoline if the historical information is correct concerning the existence of a WWII Gas Station in this area.

**Note:** Caution should be used when employing correction factors regarding the accuracy. A plus/minus of 25% should be incorporated as a buffer to the conservative.

Prior to the commencement of any field activities, the background levels of the site must be determined and noted. Daily background readings will be taken away from any areas of potential contamination. These readings, any influencing conditions (i.e., weather, temperature, humidity) and site location must be documented in the field operations logbook or other site documentation (e.g., sample log sheet).

#### **7.3.2.1 Dusts and Particulates**

As the majority of contaminants in question are solids or are likely to bind to particulates, visual observation will be employed to determine dust and particulate levels. Visual dust levels become evident at concentration approaching 2 mg/m<sup>3</sup>, at 5 mg/m<sup>3</sup> vision is obscured. Providing all dust levels are maintained below these levels, there are minimal potential for exposure.

### **7.4 INSTRUMENT MAINTENANCE AND CALIBRATION**

Hazard monitoring instruments will be maintained and pre-field calibrated by the TtNUS Equipment Manager or commercial provider. Operational checks and field calibration will be performed on all instruments each day, prior to their use. Field calibration will be performed on instruments according to manufacturer's recommendations (for example, the PID must be field calibrated daily and an additional field calibration must be performed at the end of each day to determine any significant instrument drift). These operational checks and calibration efforts will be performed in a manner that complies with the employees health and safety training, the manufacturer's recommendations, and with the applicable manufacturer standard operating procedure (copies of which can be found in the Health & Safety Guidance Manual which will be maintained on site for reference). All calibration efforts must be documented. Figure 7-1 is provided for documenting these calibration efforts. This information may instead be recorded in a field operations logbook, provided that all of the information specified in Figure 7-1 is recorded. This required information includes the following:

- Date calibration was performed
- Individual calibrating the instrument
- Instrument name, model, and serial number
- Any relevant instrument settings and resultant readings (before and after) calibration
- Identification of the calibration standard (lot no., source concentration, supplier)
- Any relevant comments or remarks

## DOCUMENTATION OF FIELD CALIBRATION

**PROJECT NO.: N3939 CTO 154**

[illegible]



## **8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS**

### **8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING**

This section is included to specify health and safety training and medical surveillance requirements for both TtNUS and subcontractor personnel participating in site activities.

#### **8.1.1 Requirements for TtNUS Personnel**

All TtNUS personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at the NTC Great Lakes facility. Additionally, TtNUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training in the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120 (e)(4) will be required for site supervisory personnel.

Documentation of TtNUS introductory, supervisory, and refresher training as well as site-specific training will be maintained at the project. Copies of certificates or other official documentation will be used to fulfill this requirement.

#### **8.1.2 Requirements for Subcontractors**

All TtNUS subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120 (e). Additionally, personnel who have had the introductory training more than 12 months ago, are required to have 8 hours of refresher training meeting the requirements of 29 CFR 1910.120 (e)(8) prior to performing field work at the NTC Great Lakes facility. TtNUS subcontractors must certify that each employee has had such training by sending TtNUS a letter, on company letterhead, containing the information in the example letter provided as in Figure 8-1 and by providing copies of certificates for all subcontractor personnel participating in site activities.

**FIGURE 8-1  
TRAINING LETTER**

The following statements must be typed on company letterhead and signed by an officer of the company and accompanied by copies of personnel training certificates:

LOGO  
XYZ CORPORATION  
555 E. 5th Street  
Nowheresville, Kansas 55555

Month, day, year

Mr. Robert Davis, P.E.  
Tetra Tech NUS, Inc.  
Task Order Manager  
Foster Plaza 7  
661 Andersen Drive  
Pittsburgh, Pennsylvania 15220

Subject: HAZWOPER Training - NTC Great Lakes facility

Dear Mr. Davis:

As an officer of XYZ Corporation, I hereby state that I am aware of the potential hazardous nature of the subject project. I also understand that it is our responsibility to comply with all applicable occupational safety and health regulations, including those stipulated in Title 29 of the Code of Federal Regulations (CFR), Parts 1900 through 1910 and Part 1926.

I also understand that Title 29 CFR 1910.120, entitled "Hazardous Waste Operations and Emergency Response," requires appropriate level of training for certain employees engaged in hazardous waste operations. In this regard, I hereby state that the following employees have had 40 hours of introductory hazardous waste site training or equivalent work experience as requested by 29 CFR 1910.120(e) and have had 8 hour of refresher training as applicable and as required by 29 CFR 1910.120(e)(8) and that site supervisory personnel have had training in accordance with 29 CFR 1910.120(e)(4).

**LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.**

Should you have any questions, please contact me at (555) 555-5555

Sincerely,

(Name and Title of Company Officer)

Enclosed: Training Certificates

## **8.2 SITE-SPECIFIC TRAINING**

TtNUS will provide site-specific training to all TtNUS employees and subcontractor personnel who will perform work on this project. Site-specific training will also be provided to all personnel (U.S. Department of Defense, EPA, etc.) who may enter the site to perform functions that may or may not be directly related to site operations. Site-Specific training will include:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Initial response procedures
- Review of the contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits

Site-specific documentation will be established through the use of Figure 8-2. All site personnel and visitors must sign this document upon receiving site-specific training.

## **8.3 MEDICAL SURVEILLANCE**

### **8.3.1 Medical Surveillance Requirements for TtNUS Personnel**

All TtNUS personnel participating in project field activities will have had a physical examination meeting the requirements of TtNUS's medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the TtNUS Tallahassee office and made available, as necessary.

**FIGURE 8-2**  
**SITE-SPECIFIC TRAINING DOCUMENTATION**

My signature below indicates that I am aware of the potential hazardous nature of performing remedial investigation activities at NTC Great Lakes, Great Lakes, Illinois and that I have received site-specific training which included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)
- Initial response procedures
- Review of the contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits

I state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction. I further state, by presence of my signature below, that the date of my training (introductory, refresher, and supervisory, as applicable) and my medical surveillance requirements are accurate and correct to the best of my knowledge.

<b>Name (Printed and Signature)</b>	<b>Site- Specific Training Date</b>	<b>40-Hour Training (Date)</b>	<b>8-Hour Refresher Training (Date)</b>	<b>8-Hour Supervisory Training (Date)</b>	<b>Medical Exam</b>

### **8.3.2      Medical Surveillance Requirements for Subcontractors**

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" provided in Figure 8-3 shall be used to satisfy this requirement, providing it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute "Subcontractor Medical Approval Form" (See Figure 8-3) with a letter, on company letterhead, containing all of the information in the example letter presented in Figure 8-4 of this HASP.

### **8.3.3      Requirements for All Field Personnel**

Each field team member (including subcontractors) and visitors entering the Exclusion Zone(s) shall be required to complete and submit a copy of Medical Data Sheet found in the TtNUS Health and Safety Guidance Manual. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

## **8.4            SUBCONTRACTOR EXCEPTIONS**

Subcontractors who will not enter the Exclusion Zone during operation, and whose activities involve no potential for exposure to site contaminants, will not be required to meet the requirements for training/medical surveillance other than site-specific training as stipulated in Section 8.2. This exception may only be granted by the CLEAN Health and Safety Manager, Matt Soltis.

**FIGURE 8-3**

**SUBCONTRACTOR MEDICAL APPROVAL FORM**

For employees of \_\_\_\_\_  
Company Name

Participant Name: \_\_\_\_\_ Date of Exam: \_\_\_\_\_

**Part A**

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f) and found to be medically -  
☐ qualified to perform work at the NTC Great Lakes facility  
☐ not qualified to perform work at the NTC Great Lakes facility  
and,
2. Undergone a physical examination as per OSHA 29 CFR 1910.134(b)(10) and found to be medically -  
☐ qualified to wear respiratory protection  
☐ not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

- ☐ A copy of OSHA Standard 29 CFR 1910.120 and appendices.
- ☐ A description of the employee's duties as they relate to the employee's exposures.
- ☐ A list of known/suspected contaminants and their concentrations (if known).
- ☐ A description of any personal protective equipment used or to be used.
- ☐ Information from previous medical examinations of the employee which is not readily available to the examining physician.

**Part B**

I, \_\_\_\_\_, have examined \_\_\_\_\_

Physician's Name (print)

Participant's Name (print)

and have determined the following information:

**FIGURE 8-3**  
**SUBCONTRACTOR MEDICAL APPROVAL FORM**  
**PAGE TWO**

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

---

---

---

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

---

---

---

3. Recommended limitations upon the employee's assigned work:

---

---

---

I have informed this participant of the results of this medical examination and any medical conditions which require further examination or treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the NTC Great Lakes facility, this participant

- ☐ may  
☐ may not

perform his/her assigned task.

Physician's Signature \_\_\_\_\_

Address \_\_\_\_\_

Phone Number \_\_\_\_\_

NOTE: Copies of test results are maintained and available at:

\_\_\_\_\_  
Address

**FIGURE 8-4**  
**MEDICAL SURVEILLANCE LETTER**

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO  
XYZ CORPORATION  
555 E. 5th Street  
Nowheresville, Kansas 55555

Mr. Robert Davis, P.E.  
Tetra Tech NUS, Inc.  
Task Order Manager  
Foster Plaza 7,  
661 Andersen Drive  
Pittsburgh, Pennsylvania 15220

Subject: Medical Clearance for Personnel Engaged in on-site activities at NTC Great Lakes, Great Lakes, Illinois

Dear Mr. Davis:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR) Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response. I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a license physician, to perform hazardous waste site work and to wear positive- and negative-pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at the OLF Bronson facility.

LIST OF FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE.

Should you have any questions, please contact me at (555) 555-5555

Sincerely,

(Name and Title of Company Officer)



## **9.0 SITE CONTROL**

This section outlines the means by which TtNUS will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a three-zone approach will be used during work at this site: Exclusion Zone, Contamination Reduction Zone, and Support Zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize potentials for the spread of contaminants and to protect individuals who are not cleared to enter the work areas.

### **9.1 EXCLUSION ZONE**

The Exclusion Zone will be considered those areas of the site of known or suspected contamination. It is not anticipated that significant amounts of surface contamination are in the proposed work areas of this site. It is anticipated that this will remain so until/unless contaminants are brought to the surface by intrusive activities such as direct push operations. Furthermore, once such activities have been completed and surface contamination has been removed, the potential for exposure is again diminished and the area can then be reclassified as part of the Contamination Reduction Zone. Therefore, the Exclusion Zones for this project will be limited to those areas if the site where active work is being performed plus so many feet surrounding the point of operation. All Exclusion Zones will be delineated using barrier tape, cones and /or drive poles, and postings to inform and direct facility personnel.

#### **9.1.1 Exclusion Zone Clearance**

Exclusion zone boundaries are as follows:

Hollow Stem Auger Drilling Operations – The exclusion zone boundary for this operation will be set at the height of the mast plus five feet. It is determined at this distance, non-essential personnel will be removed from potential physical hazards associated with this operation. This determination would include catastrophic failure of the boom and associated cables. In addition it has been determined that at this distance (typical mast height 35-feet plus 5-feet = 40-feet) will remove personnel from areas impacted by noise levels associated with these types of rigs.

Direct push operations – The height of the fully extended mast plus five feet or 25 feet, whichever is greater. This boundary demarcation has been selected based on removal of personnel from hazards

associated with this operation. In this case our primary concern is physical hazards pressurized lines and systems and noise. By establishing the line at least at 25 feet will provide a sufficient distance for protection from flying projectiles associated with pressurized systems as well as providing sufficient distance impacting noise intensity.

Groundwater sampling – 10-feet surrounding the well and discharge receptacle container.

Sediment sampling – 5-feet surrounding the point of operation.

Decontamination – Using pressure washers/steam cleaners 25-feet surrounding the point of operation or 15-feet surrounding a constructed pad.

## **9.2 CONTAMINATION REDUCTION ZONE**

The contamination reduction zone will be split to represent two separate functions. The first function will be a control/supply point for supporting exclusion zone activities. The second function, which may take place a sufficient distance from the exclusion zone, is the decontamination of personnel and heavy equipment.

In order to move from the exclusion zone to a separate location the following activities will be used:

- As samplers move from location to location during sampling activities, dedicated sampling devices and PPE will be removed, separated, and bagged. Personnel will use hygienic wipes, such as Handy Wipes, as necessary to clean hands and face until they can access soap and water.
- Muddy over-boots and gloves may be required to go through a gross contamination wash at the exclusion zone or be bagged until they can be cleaned at a central decontamination location.
- Potentially contaminated tooling will be wrapped, when necessary, for transport to the decontamination area.
- Upon completion of the assigned tasks all personnel will move through the central decontamination area to clean reusable PPE and field equipment.

### **9.3 SUPPORT ZONE**

The Support Zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the Support Zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

### **9.4 SAFE WORK PERMITS**

All Exclusion Zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit to be used is provided in Figure 9-1. Partially completed Permits for the work to be performed are included in Attachment IV. The daily meetings conducted at the site will further support these work permits. This effort will ensure all site-specific considerations and changing conditions are incorporated into the planning effort, as well as, give personnel an opportunity to ask questions and make suggestions. All permits will require the signature of the FOL or SSO.

Use of these permits will provide the communication line for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The work permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

Upon completion of the tasks for which the permit was assigned, the permit shall be turned into the FOL and/or the SSO.

## Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

1. Work limited to the following (description, area, equipment used): \_\_\_\_\_

III. Onsite Inspection conducted Yes No Initials of Inspector \_\_\_\_\_

OLF Bronson

## None

X. Special instructions, precautions: \_\_\_\_\_

CTO 0154

## 9.5 SITE VISITORS

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by TtNUS
- Regulatory personnel (DOD, OSHA, EPA, IEPA, etc.)
- Southern Division Navy Personnel
- Other authorized visitors

It is not anticipated that this operation will result in a large number of site visitors. However, as some visitors can reasonably be expected, the following requirements will be enforced:

- All site visitors will be routed to the FOL, who will sign them in to the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), who they represent, and purpose for the visit.
- All site visitors will be required to produce the necessary information supporting clearance onto the site. This includes information attesting to applicable training (40-hours of HAZWOPER training required for all Southern Division Navy personnel) and medical surveillance, as stipulated in Section 8.0 of this document, if they wish to enter operational zones during on-going activities. In addition, to enter the site's operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this document.

**NOTE: All site visitors will be escorted while at the site at all times.**

Following this, the site visitor will be permitted to enter the site and applicable operational areas. All visitors are required to observe the protective equipment and site restrictions in effect at the area of their visit. Any and all visitors not meeting the requirements as stipulated in this plan for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause all onsite activities to be terminated until that visitor can be removed. Removal of unauthorized visitors will be accomplished with support from the Base Contact, if necessary. At a minimum, the Navy On-site Representative will be notified of any unauthorized visitors.

### **9.5.1      Base Pass and Security**

Tetra Tech NUS, Inc. visitor and subcontractor access will be facilitated through the following mechanism: All persons requesting access to NTC Great Lakes will be required to submit the following information to the TOM, who will in turn pass the information to the NTC Great Lakes Point of Contact:

- Name: First, Middle, and Last
- Date of Birth
- Place of Birth
- Social Security Number
- Driver License Number

Base Access and Security will be notified by our NTC Great Lakes Point of Contact of personnel to arrive under Tetra Tech NUS, Inc. Upon arrival visitor and/or subcontractor access to NTC Great Lakes will be facilitated through Base Pass and Security located at Building 130 (near Main Gate). Hours of Operation for Base Pass and Security are 0600 – 1800.

For those persons requiring One Day Visitor Passes or Contractor Decals must have on their person to be presented at Base Pass and Security, the following information:

- Current Valid Vehicle Registration or Rental Agreement
- Valid Proof of Insurance or Rental Agreement
- Current Valid Drivers License

Failure to have these items available for review will result in denied access to NTC Great Lakes. For More information contact Base Pass and Security at (847) 688-5648

### **9.6            SITE SECURITY**

Site security will be accomplished using TtNUS field personnel. TtNUS will retain complete control over active operational areas. As this activity takes place at a United States Navy facilities open to public access, and along public highways, the first line of security will take place using traffic permit restrictions, Exclusion Zone barriers, and any existing barriers at the sites to restrict the general public. The second line of security will take place at the work site referring interested parties to the FOL or designee. The FOL will serve as a focal point for all non-project interested parties, and serve as the final line of security and the primary enforcement contact.

## **9.7 SITE MAP**

Once the areas of contamination, access routes, topography, and dispersion routes are determined, a site map will be generated and adjusted as site conditions change. When possible, these maps will be posted to illustrate up-to-date collection of contaminants and adjustment of zones and access points.

## **9.8 BUDDY SYSTEM**

Personnel engaged in on site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

## **9.9 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS**

TtNUS and subcontractor personnel will provide MSDSs for all chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of all chemicals used on site will be developed using the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request.

## **9.10 COMMUNICATION**

As personnel may not always be working in proximity to one another during field activities, a supported means of communication between field crews members will be necessary. External communication will be accomplished by using the telephones at predetermined and approved locations or through cellular phones. The hand-held radios and cellular phones that will be used, if permitted are as follows:

Motorola HT-1000	Power Output 5 watts
Cellular Phone	Power Output 5 watts

## **9.11 SANITATION AND BREAK AREAS**

This section will address the following items:

- Toilets
- Potable water

- Showers and change rooms
- Break Areas

#### **9.11.1     Toilets**

One toilet will be provided for every 20 people. All toilets will be unisex and will have locking doors. The toilet provided will either be a chemical toilet and service provider or the flush toilet readily accessible at a predetermined approved location.

#### **9.11.2     Potable Water**

Potable water, as well as, electrolyte balance sports drinks such as Gatorade will be provided to the field crews for fluid replacement, as it is necessary under conditions of ambient temperature extremes. Storage and dispensing will proceed as follows:

- All reusable containers will be clean and replenished daily.
- All containers will clearly marked as to their contents (Potable Water – Drinking Water Only; Gatorade, etc.).
- Dispensing locations will be placed in identified break areas within the support zone. The most likely location will be a break trailer or at support vehicles.
- If larger containers are used, dispensing cups will be provided.
- The coolers used for storage of potable drinks and cups will be stored in plastic bags away from potentially contaminating materials, when not in use.

#### **9.11.3     Showers and Change Rooms**

Based on this scope and duration of this project shower facilities and locker rooms will not be provided.

#### **9.11.4     Break Areas**

Given the size of the project and nature of the tasks to be conducted structured suitable locations for work breaks and warming/cooling regimens will not be necessary. These activities as necessary can take place at the site vehicles in the support zone.



## **10.0 SPILL CONTAINMENT PROGRAM**

### **10.1 SCOPE AND APPLICATION**

It is not anticipated that quantities of bulk potentially hazardous materials (greater than 55-gallons) will be handled during the site activities conducted as part of the scope of work. Significant quantities of waste water (decontamination, purge and development) and soil cuttings to be collectively referred to as Investigative-Derived Wastes (IDW) may be generated, as part of site activities. It is not anticipated, however, that spillage of these materials would constitute a significant danger to human health or the environment.

At the termination of field efforts composite samples of soil cuttings will be collected and analyzed to characterize the material and determine appropriate disposal measures. All purge and development waters will be profiled based on the information derived from the sampling data. Once characterized they can be removed from the staging area and disposed of in accordance with Federal, State and local regulations.

Disposable items such as PPE (gloves, Tyvek™), disposable tubing, and trowels will be disposed in the dumpsters at NTC Great Lakes, as general refuse.

If it is determined that all sample results indicate that sample media to be not hazardous

- These disposable items PPE, tubing, etc.) shall be disposed of as general refuse.
- Waters, if they are determined to be non-hazardous shall be pumped to the nearest identified sanitary outlet as identified by the NTC Great Lakes Representative.

If it is determined that the sample results indicate that sample media to be hazardous

- All materials associated with that site will be disposed of in accordance with Federal, State and local regulations.

### **10.2 POTENTIAL SPILL AREAS**

Potential spill areas will be monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, there are several areas vulnerable to this hazard including

- The area used for central staging and decontamination
- Transportation vessels and containers
- Resource Deployment

### **10.3 CONTAINMENT AREAS**

In order to facilitate leak and spill inspection and response, and to minimize potential hazards which may impact the integrity of the storage containers, the staging area for these substances will be structured as follows:

#### **10.3.1 Waste Storage**

- 55 Gallon Drums (United Nations 1A2 configurations) – 4 Drums to a Pallet; labels and the retaining ring bolt and nut on the outside of each drum to facilitate easy access; Minimum 4-feet between each row of pallets. The decision to construct a bermed and lined area will be the decision of project management .

The area will be identified as a Satellite Storage Area with proper signage, points of contact in the event of an emergency, alternate contacts, and identification of stored material (i.e, Purge or decontamination waters, soil cuttings, etc.).

An Inventory Log will be maintained by the FOL regarding types of waste materials and estimated volumes generated. An updated Inventory List will be provided by the FOL to the designated Emergency Response Agency or Base Contact during days off and between shifts or phases of operations.

#### **10.3.2 Flammable/POL Storage**

Flammable Storage [i.e., fuels, decontamination solvents (Isopropanol)] and Petroleum/oil/lubricants (POL) will require proper dispensing containers and necessary storage for cumulative volumes in excess of 25 gallons. Storage and dispensing will comply with the following requirements:

- All fuels, which will be stored and dispensed from portable containers, will utilize safety cans.
- All portable hand held storage containers will be labeled per Hazard Communication requirements.
- All dispensing locations will be supported by a Fire Extinguisher.

#### **10.4 MATERIALS HANDLING**

To minimize the hazards associated with moving drums and containers (i.e., lifting, pinch and compression points) material handling will be supported in the following manner:

- A drum cart with pneumatic tires will be required, if drums are used for waste storage that must be manually moved or positioned. This cart will be used to relocate drums within the staging and satellite storage location.

Other means of material handling are acceptable and may be presented to the SSO for evaluation based on their ability to minimize or eliminate material handling hazards.

#### **10.5 LEAK AND SPILL DETECTION**

To establish an early detection of potential spills or leaks, a periodic walk-around by personnel staging or disposing of containers will be conducted at least once each day during working hours, to visually determine that containers are not leaking. Any leaks identified will be collected and contained using absorbents such as Oil-dry, vermiculite, or sand, stored at the staging area in an appropriate replacement vessel or container conspicuously marked. This material too, will be containerized for disposal pending analyses. All inspections will be documented in the Project Logbook.

#### **10.6 PERSONNEL TRAINING AND SPILL PREVENTION**

All personnel will be instructed on the procedures for spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL or SSO will serve as the Spill Response Coordinator for this operation should the need arise.

#### **10.7 SPILL PREVENTION AND CONTAINMENT EQUIPMENT**

The following represents the minimum equipment that will be maintained at the staging areas at all times for the purpose of supporting this Spill Containment/Control Plan.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry)
- Extra Drums (55-gallon U.N. 1A2) should the need to transfer material from leaking containers arise.
- Pumps (Gas or Electric necessary for transferring liquids from leaking containers)/tubing
- Drum Repair Kit
- Shovels, rakes, and brooms

- Container labels
- Personal Protective Equipment
  - Nitrile outer gloves
  - Splash Shield
  - Impermeable over-boots
  - Rain suit or impermeable apron

## **10.8 SPILL CONTAINMENT/CONTROL RESPONSE PLAN**

This section describes the procedures the Tetra Tech NUS field personnel will employ upon the detection of a spill or leak.

- Notify the SSO or FOL immediately upon detection of a leak or spill.
- The FOL or the SSO shall assess the leak and make a determination as to whether the response measure required is within the capabilities of the field crew or whether it is necessary to notify designated emergency response units.

Within the capabilities of the Field Crew:

- Employ the personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point in the vessel. Spread the absorbent material in the area of the spill, covering it completely.
- Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment and disposal options.
- Recontainerize spills, including 2-inch of top cover (if over soils) impacted by the spill. Await test results for treatment or disposal options.

Outside of the Capabilities of the Field Crew/Notify Emergency Response Units:

- Activate emergency alerting procedures for that area to remove all non-essential personnel.
- Take defensive measures such as
  - Spread the absorbent material in the area of the spill, covering it completely.
  - Raising the leak to the highest point in the vessel.

- Establish site security, direct emergency crews to the area of the leak.

It is not anticipated that a spill would occur that the field crew cannot handle. Should this occur, notification of the appropriate Emergency Response agencies will be carried out by the FOL or SSO in accordance with the procedures specified in Section 2.0 of this HASP.

## 11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces.**

A confined space means a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and
- Is not designed for continuous employee occupancy.

**A Permit-Required Confined Space is a confined space that:**

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section, or
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

## 12.0 MATERIALS AND DOCUMENTATION

The TtNUS FOL shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on site, including decon solution, fuels, sample preservations, calibration gases, etc.
- A full size OSHA Job Safety and Health Poster
- Training/Medical Surveillance Documentation Form (blank)
- Emergency Reference Form (Section 2.0, extra copy for posting)

### 12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as no office trailer), these documents should be separated and immediately accessible.

**Chemical Inventory Listing (posted)** - This list represents all chemicals brought on site, including decontamination solutions, sample preservations, fuel, etc.. This list should be posted in a central area.

**Material Safety Data Sheets (MSDS) (maintained)** - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances employed on site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

**The OSHA Job Safety & Health Protection Poster (posted)** - this poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

**Site Clearance (maintained)** - This list is found within the training section of the HASP (See Figure 8-2). This list identifies all site personnel, dates of training (including site-specific training), and medical

surveillance. The lists indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

**Emergency Phone Numbers and Directions to the Hospital(s) (posted)** - This list of numbers and directions will be maintained at all phone communications points and in each site vehicle.

**Medical Data Sheets/Cards (maintained)** - Medical Data Sheets will be filled out by on site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. a copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

**Hearing Conservation Standard (29 CFR 1910.95) (posted)** - this standard will be posted anytime hearing protection or other noise abatement procedures are employed.

**Personnel Monitoring (maintained)** - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

**Placards and Labels (maintained)** - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using DOT placards and acceptable (Hazard Communication 29 CFR 1910.1200(f)) labels.

The purpose, as stated above, is to allow site personnel quick access to this information. Variations concerning location and methods of presentation are acceptable, providing the objection is accomplished.



## 13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
CPR	Cardio-Pulmonary Resuscitation
°C	Degrees Centigrade or Celsius
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action - Navy
CNS	Central Nervous System
CTO	Contract Task Order
CRZ	Contamination Reduction Zone
dBA	Decibel A-weighted scale
DRMO	Defense Reutilization Marketing Office
DOD	Department of Defense
eV	electron Volts
°F	Degrees Fahrenheit
FID	Flame Ionization Detector
FOL	Field Operations Leader
GC	Gas Chromatograph
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air Filter
HSA	Hollow Stem Auger
HSM	Health and Safety Manager
IAS	Initial Assessment Study
IDLH	Immediate Dangerous to Life or Health
IDW	Investigative-Derived Wastes
LEL/LFL	Lower Explosive Limit / Lower Flammable Limit
µg/L	micrograms per liter
µg/kg	micrograms per kilograms
mg/m <sup>3</sup>	milligrams per cubic meter
MSDS	Material Safety Data Sheets

N/A	Not Available
NAS	Naval Air Station
NIOSH	National Institute for Occupational Safety and Health
NTC	Naval Training Center
NTP	National Toxicity Program
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PAPR	Powered Air Purifying Respirator
PEL	Permissible Exposure Limit
PID	Photoionization Detector
ppm	Parts per million
PPE	Personal Protective Equipment
RI	Remedial Investigation
RTC	Recruit Training Command
SAP	Sampling and Analyses Plan
SOPs	Standard Operating Procedures
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
TBD	To be determined
TLV	Threshold Limit Value
TOM	Task Order Manager
TWA	Time-Weighted Average
WP	Work Plan

## **ATTACHMENT I**

# **INJURY/ILLNESS PROCEDURE AND REPORT FORM**



## **TETRA TECH NUS, INC.**

### **INJURY/ILLNESS PROCEDURE WORKER'S COMPENSATION PROGRAM**

---

#### **WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:**

- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room.
- If incident involves a chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Diethorn at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 within 24 hours. You will be required to complete an Injury/Illness Report (attached). You may also be required to participate in a more detailed investigation from the Health Sciences Department.
- If further medical treatment is needed, The Hartford Network Referral Unit will furnish a list of network providers customized to the location of the injured employee. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work. Please call Marilyn Diethorn at (412) 921-8475 for the number of the Referral Unit.

#### **ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:**

Contact your local human resources representative, corporate health and safety coordinator, or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries (Tetra Tech or Company) pay premiums on behalf of their employees. The type of injuries or illnesses covered and the amount of benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

#### **WHO IS COVERED:**

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits.



case no. \_\_\_\_\_

All employees must follow the above injury/illness reporting procedures. Consultants, independent contractors, and employees of subcontractors are not covered by Tetra Tech's Worker's Compensation plan.

**WHAT IS COVERED:**

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported. Please note that if you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.



case no. \_\_\_\_\_

**TETRA TECH NUS, INC.**  
**INJURY/ILLNESS PROCEDURE**  
**WORKER'S COMPENSATION PROGRAM**

---

To: Corporate Health and Safety Manager  
Human Resource Administrator

Prepared by: \_\_\_\_\_

Position: \_\_\_\_\_

Project Name: \_\_\_\_\_

Office: \_\_\_\_\_

Project No. \_\_\_\_\_

Telephone: \_\_\_\_\_

**Information Regarding Injured or Ill Employee:**

Name: \_\_\_\_\_

Office: \_\_\_\_\_

Home address: \_\_\_\_\_  
\_\_\_\_\_Gender: M ☐ F ☐ No. of dependents: \_\_\_\_\_

Home telephone: \_\_\_\_\_

Marital status: \_\_\_\_\_

Occupation (regular job title): \_\_\_\_\_

Date of birth: \_\_\_\_\_

Department: \_\_\_\_\_

Social Security No.: \_\_\_\_\_

Date of Accident: \_\_\_\_\_

Time of Accident: \_\_\_\_\_

**Location of Accident** Was place of accident or exposure on employer's premises Yes ☐ No ☐

Street address: \_\_\_\_\_

City, state, and zip code: \_\_\_\_\_

County: \_\_\_\_\_

**Narrative Description of How Accident Occurred:** (Be specific. Explain what the employee was doing and how the accident occurred.)



**TETRA TECH, INC.**  
**INJURY/ILLNESS REPORT**

Did employee die? Yes ☐ No ☐

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐

Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this accident report.

**Witness(es):**

Name:

Address:

Telephone:

**Describe the Illness or Injury and Part of Body Affected:**

**Name the Object or Substance which Directly Injured the Employee:**

**Medical Treatment Required:**

☐ No ☐ Yes ☐ First Aid Only

Physician's Name: \_\_\_\_\_

Address: \_\_\_\_\_

Hospital or Office Name: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone No.: \_\_\_\_\_

**Lost Work Days:**

☐ No. of Lost Work Days \_\_\_\_\_

Last Date Worked \_\_\_\_\_

Time Employee Left Work \_\_\_\_\_

Date Employee Returned to Work \_\_\_\_\_

☐ No. of Restricted Work Days \_\_\_\_\_

☐ None

**Corrective Action(s) Taken by Unit Reporting the Accident:**

**Corrective Action Still to be Taken (by whom and when):**

**Name of Tetra Tech employee the injury or illness was first reported to:** \_\_\_\_\_

**Date of Report:** \_\_\_\_\_ **Time of Report:** \_\_\_\_\_

	Printed Name	Signature	Telephone No.	Date
Project or Office Manager				
Site Safety Coordinator				
Injured Employee				

**To be completed by Human Resources:**

Date of hire:

Hire date in current job:

Wage information: \$ \_\_\_\_\_ per \_\_\_\_\_ (hour, day, week, or month)

Position at time of hire:

Shift hours:

State in which employee was hired:

Status: ☐ Full-time ☐ Part-time Hours per week: \_\_\_\_\_ Days per week: \_\_\_\_\_

Temporary job end date:

**To be completed during report to workers' compensation insurance carrier:**

Date reported:

Reported by:

TeleClaim phone number:

TeleClaim account number:

Location code:

Confirmation number:

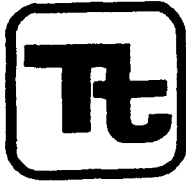
Name of contact:

Field office of claims adjuster:



## **ATTACHMENT II**

# **STANDARD OPERATING PROCEDURE FOR UTILITY LOCATING AND EXCAVATION CLEARANCE**



TETRA TECH NUS, INC.

# STANDARD OPERATING PROCEDURES

Number	HS-1.0	Page	1 of 11
Effective	03/00	Date	Revision
			1
Applicability	Tetra Tech NUS, Inc.		
Prepared	Health & Safety		
Approved	D. Senovich <i>[Signature]</i>		

Subject  
UTILITY LOCATING AND EXCAVATION CLEARANCE

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 PURPOSE .....	2
2.0 SCOPE .....	2
3.0 GLOSSARY .....	2
4.0 RESPONSIBILITIES.....	2
5.0 PROCEDURES.....	3
5.1 BURIED UTILITIES .....	3
5.2 OVERHEAD POWER LINES .....	4
6.0 UNDERGROUND LOCATING TECHNIQUES.....	5
6.1 GEOPHYSICAL METHODS.....	5
6.2 PASSIVE DETECTION SURVEYS .....	6
6.3 INTRUSIVE DETECTION SURVEYS.....	7
7.0 INTRUSIVE ACTIVITIES SUMMARY .....	7
8.0 REFERENCES .....	7

## ATTACHMENTS

1	Listing of Underground Utility Clearance Resources.....	8
2	Frost Line Penetration Depths by Geographic Location .....	10
3	Utility Clearance Form .....	11

Subject <b>UTILITY LOCATING AND EXCAVATION CLEARANCE</b>	Number <b>HS-1.0</b>	Page <b>2 of 11</b>
	Revision <b>1</b>	Effective Date <b>03/00</b>

## **1.0 PURPOSE**

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy must be reviewed by anyone potentially involved with underground or overhead utility services.

## **2.0 SCOPE**

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence or absence of utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the geophysical methods may also be required.

## **3.0 GLOSSARY**

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer - A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey - A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection - A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer - A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar - Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

## **4.0 RESPONSIBILITIES**

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure and the TtNUS Utility Locating and Clearance Policy.

Subject	Number	Page
	HS-1.0	3 of 11
UTILITY LOCATING AND EXCAVATION CLEARANCE	Revision	Effective Date
	1	03/00

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy.

Site Personnel – Responsible for understanding and implementing this SOP and the TtNUS Utility Locating and Clearance Policy.

**5.0 PROCEDURES**

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

**5.1 Buried Utilities**

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. The following procedure must be followed prior to beginning any excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.
- 2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scars and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 4 of 11
	Revision 1	Effective Date 03/00

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.
4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, "one call" systems may still be required to provide location services on military installations.
5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using such methods as passive and intrusive surveys, physical probing, or hand augering. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in many states, initial excavation is required by hand to a specified depth.
7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand auger or pole (tile probe) made of non-conductive material. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.
8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

## 5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number  HS-1.0	Page  5 of 11
	Revision  1	Effective Date  03/00

though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

<u>Nominal Voltage</u>	<u>Minimum Clearance</u>
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

**6.0 UNDERGROUND LOCATING TECHNIQUES**

**6.1 Geophysical Methods**

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

**Electromagnetic Induction**

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

**Magnetics**

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 6 of 11
	Revision 1	Effective Date 03/00

## **Ground Penetrating Radar**

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

### **6.2 Passive Detection Surveys**

#### **Acoustic Surveys**

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

#### **Thermal Imaging**

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

### **6.3 Intrusive Detection Surveys**

#### **Vacuum Excavation**

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

#### **Hand-auger Surveys**

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings must be hand-augered for all locations where there is a potential to impact buried utilities. The minimum hand-auger depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the

Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number  HS-1.0	Page  7 of 11
	Revision  1	Effective Date  03/00

placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand-auger depths must be at least to the frost line depth plus two (2) feet, but never less than 4 feet below ground surface (bgs). For augering, the hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand-auger. It is important to note that a post-hole digger must not be used in place of a hand-auger.

### **Tile Probe Surveys**

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand-augers. Tile probes must be performed to the same depth requirements as hand-augers. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

## **7.0 INTRUSIVE ACTIVITIES SUMMARY**

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.
2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service. If possible, arrange for an appointment to show the One Call representative the subsurface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.
4. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

## **8.0 REFERENCES**

TtNUS Utility Locating and Clearance Policy  
TtNUS SOP GH-3.1; Resistivity and Electromagnetic Induction  
TtNUS SOP GH-3.2; Magnetic and Metal Detection Surveys  
TtNUS SOP GH-3.4; Ground-penetrating Radar Surveys



Subject  UTILITY LOCATING AND EXCAVATION CLEARANCE	Number HS-1.0	Page 8 of 11
	Revision 1	Effective Date 03/00

# **ATTACHMENT 1** **LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES**

<b>ALABAMA</b> Alabama Line Location (800) 292-8525 Tucson Blue Stake Center (800) 782-5348	<b>Maine</b> Dig Safe – Maine (800) 225-4977
<b>Alaska</b> Locate Call Center of Alaska Inc. (800) 478-3121	<b>Maryland</b> Miss Utility (800) 257-7777
<b>Arizona</b> Arizona Blue Stake Inc. (800) 782-5348	<b>Miss Utility of Delmarva</b> (800) 282-8555
<b>Arkansas</b> Arkansas One Call System Inc. (800) 482-8998	<b>Massachusetts</b> Dig Safe – Massachusetts (800) 322-4844
<b>California</b> Underground Service Alert North (800) 227-2600 Underground Service Alert South (800) 227-2600	<b>Michigan</b> Miss Dig System (800) 482-7171
<b>Colorado</b> Utility Notification Center of Colorado (800) 922-1987	<b>Minnesota</b> Gopher State One Call (800) 252-1166
<b>Connecticut</b> Call Before You Dig (800) 922-4455	<b>Mississippi</b> Mississippi One-Call System Inc. (800) 227-6477
<b>Delaware</b> Miss Utility of Delmarva (800) 282-8555	<b>Missouri</b> Missouri One Call System Inc. (800) 344-7483
<b>District of Columbia</b> Miss Utility (800) 257-7777	<b>Montana</b> Utilities Underground Location Center (800) 424-5555
<b>Florida</b> Call Sunshine (800) 432-4770	<b>Montana One Call Center</b> (800) 551-8344
<b>Georgia</b> Utilities Protection Center Inc. (800) 282-7411	<b>Nebraska</b> Diggers Hotline of Nebraska (800) 331-5666
<b>Idaho</b> Palouse Empire Underground Coordinating Council (800) 882-1974  Utilities Underground Location Center (800) 424-5555  Kootenai Country Utility Coordinating Council (800) 428-4950  Shoshone County One Call (800) 398-3285  Dig Line (800) 342-1585  One Call Concepts (800) 626-4950	<b>Nevada</b> Underground Service Alert North (800) 227-2600
<b>Illinois</b> Julie Inc. (800) 892-0123  Digger (Chicago Utility Alert Network) (312) 744-7000	<b>New Hampshire</b> Dig Safe – New Hampshire (800) 225-4977
<b>Indiana</b> Indiana Underground Plant Protection Services (800) 382-5544	<b>New Jersey</b> New Jersey One Call (800) 272-1000
<b>Iowa</b> Underground Plant Location Service Inc. (800) 292-8989	<b>New Mexico</b> New Mexico One Call System Inc. (800) 321-ALERT  Las Cruces-Dona Utility Council (505) 526-0400
<b>Kansas</b> Kansas One-Call Center (800) 344-7233	<b>New York</b> Underground Facilities Protection Organization (800) 962-7962  New York City: Long Island One Call Center (800) 272-4480
<b>Kentucky</b> Kentucky Underground Protection Inc. (800) 752-6007	<b>North Carolina</b> The North Carolina One-Call Center Inc. (800) 632-4949
<b>Louisiana</b> Louisiana One Call (800) 272-3020	<b>North Dakota</b> Utilities Underground Location Center (800) 795-0555
	<b>Ohio</b> Ohio Utilities Protection Service (800) 362-2764  Oil & Gas Producers Underground Protection Service (800) 925-0988
	<b>Oklahoma</b> Call Okie (800) 522-6543

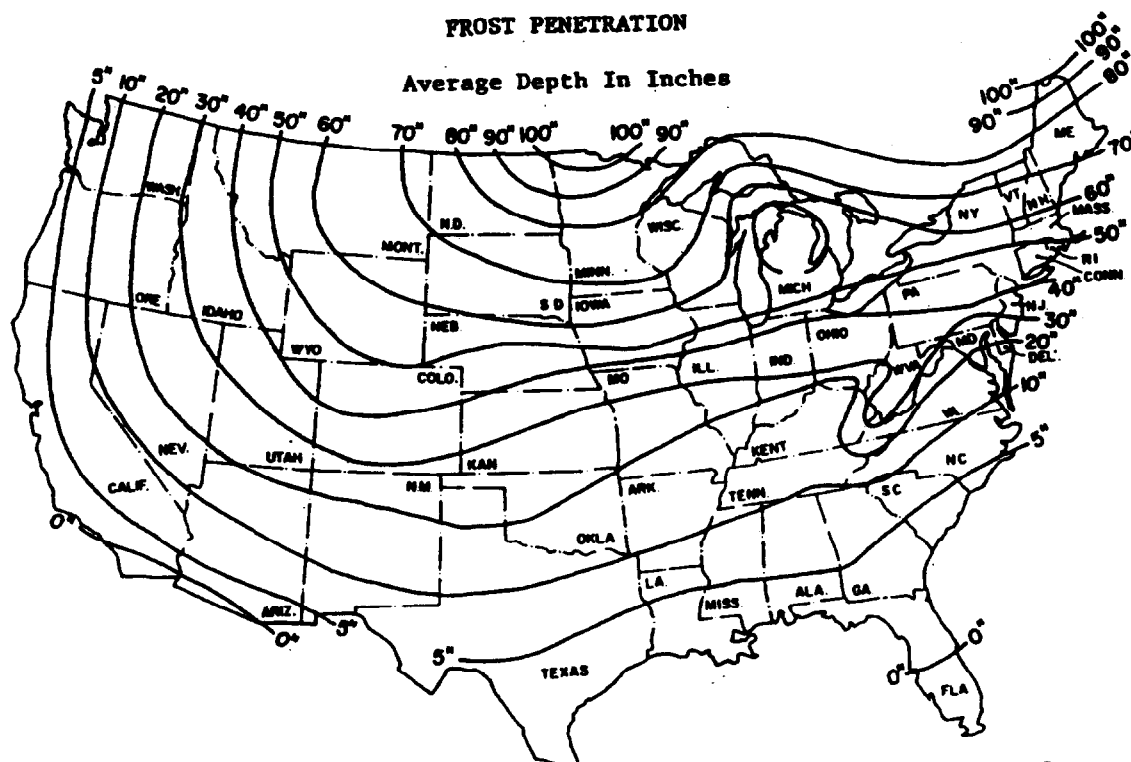
Subject	Number	Page
	HS-1.0	9 of 11
UTILITY LOCATING AND EXCAVATION CLEARANCE	Revision	Effective Date
	1	03/00

<b>Oregon</b> Utilities Underground Location Center (800) 424-5555  Douglas Utilities Coordinating Council (503) 673-6676  Josephine Utilities Coordinating Council (503) 476-6676  Rogue Basin Utility Coordinating Council (503) 779-6676  Utilities Notification Center (800) 332-2344	<b>Wyoming</b> West Park Utility Coordinating Council (307) 587-4800  Call-In Dig-In Safety Council (800) 300-9811  Fremont County Utility Coordinating Council (800) 489-8023  Central Wyoming Utilities Coordinating Council (800) 759-8035  Southwest Wyoming One Call (307) 362-8888  Carbon County Utility Utility Coordinating Council (307) 324-6666  Albany County Utility Coordinating Council (307) 742-3615  Southeast Wyoming Utilities Coordinating Council (307) 638-6666  Wyoming One-Call (800) 348-1030  Utilities Underground Location Center (800) 454-5555  Converse County Utility Coordination Council (800) 562-5561
<b>Pennsylvania</b> Pennsylvania One Call System Inc. (800) 242-1776	
<b>Rhode Island</b> Dig Safe - Rhode Island (800) 225-4977	
<b>South Carolina</b> Palmetto Utility Protection Service Inc. (800) 922-0983	
<b>South Dakota</b> South Dakota One Call (800) 781-7474	
<b>Tennessee</b> Tennessee One-Call System (800) 351-1111	
<b>Texas</b> Texas One Call System (800) 245-4545  Texas Excavation Safety System (800) 344-8377  Lone Star Notification Center (800) 669-8344	
<b>Utah</b> Blue Stakes Location Center (800) 662-4111	
<b>Vermont</b> Dig Safe - Vermont (800) 225-4977	
<b>Virginia</b> Miss Utility of Virginia (800) 552-7001  Miss Utility (800) 257-7777  Miss Utility of Delmarva (800) 441-8355	
<b>Washington</b> Utilities Underground Location Center (800) 424-5555  Grays Harbor & Pacific County Utility Coordinating Council (206) 535-3550  Utilities County of Cowlitz County (360) 425-2506  Chelan-Douglas Utilities Coordinating Council (509) 663-6111  Upper Yakima County Underground Utilities Council (800) 553-4344  Inland Empire Utility Coordinating Council (509) 456-8000  Palouse Empire Utilities Coordinating Council (800) 822-1974  Utilities Notification Center (800) 332-2344	
<b>West Virginia</b> Miss Utility of West Virginia Inc. (800) 245-4848	
<b>Wisconsin</b> Diggers Hotline Inc. (800) 242-8511	

## ATTACHMENT 2

### FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

<b>Subject</b> UTILITY LOCATING AND EXCAVATION CLEARANCE	<b>Number</b> HS-1.0 <hr/> <b>Revision</b> 1	<b>Page</b> 11 of 11 <hr/> <b>Effective Date</b> 03/00
--	---	---

**ATTACHMENT 3**  
**UTILITY CLEARANCE FORM**

Client: \_\_\_\_\_ Project Name: \_\_\_\_\_  
 Project No.: \_\_\_\_\_ Completed By: \_\_\_\_\_  
 Location Name: \_\_\_\_\_ Work Date: \_\_\_\_\_  
 Excavation Method/Overhead Equipment: \_\_\_\_\_

1. Underground Utilities

a) Review of existing maps? \_\_\_\_\_

b) Interview local personnel? \_\_\_\_\_

c) Site visit and inspection? \_\_\_\_\_

d) Excavation areas marked in the field? \_\_\_\_\_

e) Utilities located in the field? \_\_\_\_\_

f) Located utilities marked/added to site maps? \_\_\_\_\_

g) Client contact notified \_\_\_\_\_

Name \_\_\_\_\_ Telephone: \_\_\_\_\_ Date: \_\_\_\_\_

g) State One-Call agency called? \_\_\_\_\_

Caller: \_\_\_\_\_

Ticket Number: \_\_\_\_\_ Date: \_\_\_\_\_

h) Geophysical survey performed? \_\_\_\_\_

Survey performed by: \_\_\_\_\_

Method: \_\_\_\_\_ Date: \_\_\_\_\_

i) Hand augering performed? \_\_\_\_\_

Augering completed by: \_\_\_\_\_

Total depth: \_\_\_\_\_ feet Date: \_\_\_\_\_

j) Trench/excavation probed? \_\_\_\_\_

Probing completed by: \_\_\_\_\_

Depth/frequency: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One

yes no N/A

yes no N/A

yes no N/A

yes no N/A

yes no N/A

yes no N/A

yes no N/A

yes no N/A

yes no N/A

yes no

yes no N/A

yes no N/A

yes no N/A

N/A

2. Overhead Utilities

a) Determination of nominal voltage \_\_\_\_\_

b) Marked on site maps \_\_\_\_\_

c) Necessary to lockout/insulate/re-route \_\_\_\_\_

d) Document procedures used to lockout/insulate/re-route \_\_\_\_\_

e) Minimum acceptable clearance (SOP Section 5.2): \_\_\_\_\_

**Present Absent**

yes no N/A

yes no N/A

yes no N/A

yes no N/A

3. Notes: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Approval: \_\_\_\_\_

Site Manager/Field Operations Leader \_\_\_\_\_

Date \_\_\_\_\_

c: PM/Project File  
 Program File

## **ATTACHMENT III**

# **EQUIPMENT INSPECTION CHECKLISTS**

# EQUIPMENT INSPECTION FOR DRILL RIGS

**COMPANY:** \_\_\_\_\_ **UNIT NO.** \_\_\_\_\_

**FREQUENCY:** Inspect at the initiation of the project, after repairs, once every 10-day shift.

Inspection Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Time: \_\_\_\_\_ Equipment Type: \_\_\_\_\_  
(e.g., Drill Rigs Hollow Stem, Mud Rotary, Direct Push)

	Good	Need Repair	N/A
Emergency Stop Devices (At points of operation)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tires (Tread) or tracks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hoses and belts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cab, mirrors, safety glass	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Is the equipment equipped with audible back-up alarms and back-up lights?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Horn and gauges	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Brake condition (dynamic, park, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fire extinguisher (Type/Rating - _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fluid Levels:			
- Engine oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Transmission fluid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Brake fluid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Cooling system fluid	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Windshield wipers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Hydraulic oil	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oil leak/lube	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coupling devices and connectors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Exhaust system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mast condition (Mast Height _____)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Access-ways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Steering (standard and emergency)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Power cable and/or hoist cable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
➤ Hooks (As Applicable )			
- Safety Latch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Wear in excess of 10% original dimension	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- A bend or twist exceeding 10% from the plane of an unbent hook	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Increase in throat opening exceeding 15% from new condition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Excessive nicks and/or gouges	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
➤ Wire Rope (Hoist Mechanism, As Applicable )			
- Reduction in Rope diameter (5/16 wire rope > 1/64 reduction nominal size -replace) (3/8 to 1/2 wire rope > 1/32 reduction nominal size-replace) (9/16 to 3/4 wire rope > 3/64 reduction nominal size-replace)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Number of broken wires (12 randomly broken wires in one rope lay) (4 broken wires in one strand)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Number of wire rope wraps left on the Running Drum at nominal use (≥3 required)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Lead (primary) sheave is centered on the running drum	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Lubrication of wire rope (adequate?)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Good	Needs Repaired	N/A
- Number of U-Type (Crosby) Clips (5/16 – 5/8 = 3 clips minimum) (3/4 – 1 inch = 4 clips minimum) (1 1/8 – 1 3/8 inch = 5 clips minimum)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
➤ Kinks, bends – Flattened to > 50% diameter	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
➤ Hemp/Fiber rope (Cathead/Split Spoon Hammer)			
- Minimum 3/4; maximum 1 inch rope diameter (Inspect for physical damage)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Rope to hammer is securely fastened	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

#### **Safety Guards:**

Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact? \_\_\_\_\_

**Yes No**

☐ ☐

Hot pipes and surfaces exposed to accidental contact? \_\_\_\_\_

☐ ☐

All emergency shut offs have been identified and communicated to the field crew? \_\_\_\_\_

☐ ☐

Are any structural members bent, rusted, or otherwise show signs of damage? \_\_\_\_\_

☐ ☐

Are fueling cans used with this equipment approved type safety cans? \_\_\_\_\_

☐ ☐

Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use? \_\_\_\_\_

☐ ☐

#### **Cleanliness:**

Overall condition (was the decontamination performed prior to arrival on-site considered acceptable)? \_\_\_\_\_

Where was this equipment used prior to its arrival on site? \_\_\_\_\_

Site Contaminants of concern at the previous site? \_\_\_\_\_

Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls? \_\_\_\_\_

Flammable solvents stored in the operators cab? \_\_\_\_\_

#### **Operator Qualifications (as applicable for all heavy equipment):**

Does the operator have proper licensing where applicable, (e.g., CDL)? \_\_\_\_\_

Does the operator, understand the equipment's operating instructions? \_\_\_\_\_

Is the operator experienced with this equipment? \_\_\_\_\_

Is the operator 21 years of age or more? \_\_\_\_\_

#### **ADDITIONAL INSPECTION REQUIRED PRIOR TO USE ON-SITE**

Does equipment emit noise levels above 90 decibels? \_\_\_\_\_

**Yes**

**No**

☐

☐

If so, has an 8-hour noise dosimetry test been performed? \_\_\_\_\_

☐

☐

Results of noise dosimetry: \_\_\_\_\_

Defects and repairs needed: \_\_\_\_\_

General Safety Condition: \_\_\_\_\_

Operator or mechanic signature: \_\_\_\_\_

Site Safety Officer Signature: \_\_\_\_\_

Approved for Use: ☐ Yes

☐ No

**ATTACHMENT IV**

**SAFE WORK PERMITS**



**SAFE WORK PERMIT  
DECONTAMINATION ACTIVITIES  
NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

**SECTION I: General Job Scope**

- I. Work limited to the following (description, area, equipment used): Decontamination of sampling equipment, machinery (i.e., drill rigs and flights, excavator). Brushes and spray bottles will be used to decontaminate small sampling equipment. Pressure washers or steam cleaning units will be used to decontaminate heavy equipment.
- II. Required Monitoring Instrument(s): None
- III. Field Crew: \_\_\_\_\_
- IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector TtNUS

**SECTION II: General Safety Requirements (To be filled in by permit issuer)**

- V. Protective equipment required  
 Level D ☒ Level B ☐  
 Level C ☐ Level A ☐  
 Detailed on Reverse
- Respiratory equipment required  
 Full face APR ☐  
 Half face APR ☐  
 SKA-PAC SAR ☐  
 Skid Rig ☐
- Escape Pack ☐  
 SCBA ☐  
 Bottle Trailer ☐  
 None ☒

Modifications/Exceptions: \_\_\_\_\_

VI. Chemicals of Concern	Action Level(s)	Response Measures
<u>Decontamination Solvents</u>		<u>Per MSDS</u>

- VII. Additional Safety Equipment/Procedures
- |                                     |   |                                       |   |
|-------------------------------------|---|---------------------------------------|---|
| Hard-hat .....                      | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Hearing Protection (Plugs/Muffs)..... | <input type="checkbox"/> Yes <input type="checkbox"/> No            |
| Safety Glasses .....                | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Safety belt/harness.....              | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical/splash goggles .....       | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Radio.....                            | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash Shield .....                 | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Barricades .....                      | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash suits/coveralls.....         | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Gloves (Type - Nitrile) .....         | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Steel toe Work shoes or boots ..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Work/rest regimen.....                | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical Resistant Boot Covers..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Impermeable apron .....               | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |

Modifications/Exceptions: PVC rain suits or PE or PVC coated Tyvek for protection against splashes and overspray, if impermeable aprons do not provide adequate protection against overspray or backsplash. Chemical resistant boot covers if excessive liquids are generated or to protected footwear. Hearing protection is required when operating the steam cleaner or pressure washer.

- VIII. Procedure review with permit acceptors Yes NA  
 Safety shower/eyewash (Location & Use)..... ☐ ☐  
 Procedure for safe job completion..... ☐ ☐  
 Contractor tools/equipment/PPE inspected..... ☒ ☐
- Emergency alarms..... ☒ ☐  
 Evacuation routes..... ☐ ☐  
 Assembly points ( ) ☐ ☐

- IX. Site Preparation Yes No NA  
 Utility Locating and Excavation Clearance completed..... ☐ ☐ ☒  
 Vehicle and Foot Traffic Routes Cleared and Established .....

**SAFE WORK PERMIT**  
**MOBILIZATION/DEMOLITION ACTIVITIES**  
**NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

**SECTION I: General Job Scope**

- I. Work limited to the following (description, area, equipment used): Mobilization and demobilization activities.
- II. Required Monitoring Instruments: None
- III. Field Crew: \_\_\_\_\_
- IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector TtNUS

**SECTION II: General Safety Requirements (To be filled in by permit issuer)**

- V. Protective equipment required
- |   |                                  |
|---|----------------------------------|
| Level D <input checked="" type="checkbox"/> | Level B <input type="checkbox"/> |
| Level C <input type="checkbox"/>            | Level A <input type="checkbox"/> |
| Detailed on Reverse                         |                                  |
- Respiratory equipment required
- |  |  |
|--|--|
| Full face APR <input type="checkbox"/> | Escape Pack <input type="checkbox"/>     |
| Half face APR <input type="checkbox"/> | SCBA <input type="checkbox"/>            |
| SKA-PAC SAR <input type="checkbox"/>   | Bottle Trailer <input type="checkbox"/>  |
| Skid Rig <input type="checkbox"/>      | None <input checked="" type="checkbox"/> |

Modifications/Exceptions: None anticipated

- | VI. Chemicals of Concern | Action Level(s) | Response Measures |
|--------------------------|-----------------|-------------------|
| <u>None anticipated</u>  | _____           | _____             |

- VII. Additional Safety Equipment/Procedures
- |   |   |                                      |   |
|---|---|--------------------------------------|---|
| Hard-hat .....  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Hearing Protection (Plugs/Muffs) ... | <input type="checkbox"/> Yes <input type="checkbox"/> No            |
| Safety Glasses .....                                    | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Safety belt/harness .....            | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical/splash goggles .....                           | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Radio .....                          | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash Shield .....                                     | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Barricades .....                     | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash suits/coveralls .....                            | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Gloves (Type - ) .....               | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Steel toe Work shoes or boots ....                      | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Work/rest regimen .....              | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical Resistant Boot Covers <input type="checkbox"/> | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Impermeable apron .....              | <input type="checkbox"/> Yes <input type="checkbox"/> No            |

Modifications/Exceptions: Hazards associated with this activity are physical in nature such as lifting, site preparation, and construction of barricades around control zones. Each task shall be evaluated by the SSO to determine the need for additional PPE. For example to minimize the potential effects of these hazards (safety glasses will be selected for hammering and operation of power tools), hard hats will be employed when overhead hazards exist. Selection of additional items will be based on site-specific conditions.

- |  |                          |                                     |                           |                                     |                          |
|--|--------------------------|-------------------------------------|---------------------------|-------------------------------------|--------------------------|
| VIII. Procedure review with permit acceptors   | Yes                      | NA                                  | Emergency alarms .....    | Yes                                 | NA                       |
| Safety shower/eyewash (Location & Use) .....   | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Evacuation routes .....   | <input type="checkbox"/>            | <input type="checkbox"/> |
| Procedure for safe job completion .....        | <input type="checkbox"/> | <input checked="" type="checkbox"/> | Assembly points ( ) ..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Contractor tools/equipment/PPE inspected ..... | <input type="checkbox"/> | <input type="checkbox"/>            |                           |                                     |                          |

- IX. Site Preparation
- |   |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|
| Utility Locating and Excavation Clearance completed .....     | Yes                      | No                       | NA                       |
| Vehicle and Foot Traffic Routes Cleared and Established ..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physical Hazards Barricaded and Isolated .....                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Emergency Equipment Staged .....                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- X. Additional Permits required (Hot work, confined space entry, excavation etc.) ..... ☐ Yes ☐ No  
*If yes, complete permit required or contact Health Sciences, Pittsburgh Office*

- XI. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.). Remove or barricade as appropriate. Establish and construct traffic patterns to segregate pedestrian and vehicular/equipment traffic. Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for this task.

Permit Issued by: \_\_\_\_\_ Permit Accepted by: \_\_\_\_\_

**SAFE WORK PERMIT**  
**MULTI-MEDIA SAMPLING ACTIVITIES**  
**NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

**SECTION I: General Job Scope**

- I. Work limited to the following (description, area, equipment used): Multi media sampling including soils (surface and sub surface); sediments; groundwater and IDW.
- II. Required Monitoring Instrument(s): PID with a 10.6 eV Lamp Strength (See Table 5-1)
- III. Field Crew: \_\_\_\_\_
- IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector TINUS

**SECTION II: General Safety Requirements (To be filled in by permit issuer)**

- V. Protective equipment required Respiratory equipment required
- |  |  |  |
|--|--|--|
| Level D <input checked="" type="checkbox"/> Level B <input type="checkbox"/> | Full face APR <input type="checkbox"/> | Escape Pack <input type="checkbox"/>     |
| Level C <input type="checkbox"/> Level A <input type="checkbox"/>            | Half face APR <input type="checkbox"/> | SCBA <input type="checkbox"/>            |
| Detailed on Reverse  | SKA-PAC SAR <input type="checkbox"/>   | Bottle Trailer <input type="checkbox"/>  |
|  | Skid Rig <input type="checkbox"/>      | None <input checked="" type="checkbox"/> |

Modifications/Exceptions: Minimum requirement are stated below. Ascension to Level C protection will be based on measured or visible dust concentrations >2 mg/m<sup>3</sup> or volatile emissions >10 ppm for sustained duration of 10 minutes with no more than 4 occurrences per day. Level C protection will consist of full-face APR with organic vapor/HEPA cartridges for protection against airborne dust concentrations. It should be noted that this is not anticipated since airborne hosts are unlikely to be generated.

VI. Chemicals of Concern	Action Level(s)	Response Measures
*General Contaminants Classifications	>10ppm/>10 minute duration/4 times/day	Notify PHSO
Dusts and Particulates	>2 mg/m <sup>3</sup> (Visible dust)	Dust Suppression/Area Wetting

VII. Additional Safety Equipment/Procedures

- |                                      |   |                                       |   |
|--------------------------------------|---|---------------------------------------|---|
| Hard-hat.....                        | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Hearing Protection (Plugs/Muffs)..... | <input type="checkbox"/> Yes <input type="checkbox"/> No            |
| Safety Glasses .....                 | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Safety belt/harness.....              | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical/splash goggles.....         | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Radio .....                           | <input type="checkbox"/> Yes <input type="checkbox"/> No            |
| Splash Shield.....                   | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Barricades .....                      | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash suits/coveralls .....         | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Gloves (Type - Nitrile).....          | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Steel toe Work shoes or boots.....   | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Work/rest regimen .....               | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical Resistant Boot Covers ..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Impermeable apron .....               | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |

Modifications/Exceptions: Tyvek coverall if there is a potential for soiling work clothes and PVC or PE coated Tyvek if saturation or work clothes may occur. Impermeable aprons may be used in lieu of the coveralls if it can be demonstrated that it offers as much protection as the coveralls. This modification may be made to support measures against effects of heat stress

- VIII. Procedure review with permit acceptors Yes NA
- |  |  |                         |   |
|--|--|-------------------------|---|
| Safety shower/eyewash (Location & Use) .....   | <input type="checkbox"/> Yes <input type="checkbox"/> NA | Emergency alarms .....  | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> NA |
| Procedure for safe job completion .....        | <input type="checkbox"/> Yes <input type="checkbox"/> NA | Evacuation routes ..... | <input type="checkbox"/> Yes <input type="checkbox"/> NA            |
| Contractor tools/equipment/PPE inspected ..... | <input type="checkbox"/> Yes <input type="checkbox"/> NA | Assembly points.....    | <input type="checkbox"/> Yes <input type="checkbox"/> NA            |

- IX. Site Preparation Yes No NA
- |  |  |
|--|--|
| Utility Locating and Excavation Clearance completed .....    | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA |
| Vehicle and Foot Traffic Routes Cleared and Established..... | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA |
| Physical Hazards Barricaded and Isolated .....               | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA |
| Emergency Equipment Staged .....                             | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA |

- X. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☐ No  
*If yes, complete permit required or contact Health Sciences, Pittsburgh Office*

- XI. Special instructions, precautions: The FOL and/or the SSO shall preview all work areas for physical hazards where sampling is to be conducted. Physical hazards will be removed, barricaded, or indicated to exist to the field crew prior to committing personnel or resources. Personal decontamination for this task shall include efforts at remote locations such as bagging contaminated PPE and reusable sampling tools and using hygienic wipes for hands and face until persons can reach the structured decontamination unit. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for mobilization/demobilization. For remote locations pack glass ware in hard sided containers to prevent breakage of glassware and possible lacerations.

\* - General Contaminant Classifications – Waste/residual oils, Paints (Pigments), Inks, Thinners, and Solvents

Permit Issued by: \_\_\_\_\_ Permit Accepted by: \_\_\_\_\_

**SAFE WORK PERMIT**  
**MONITORING WELL INSTALLATION/SOIL BORING ACTIVITIES**  
**NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

**SECTION I: General Job Scope**

- I. Work limited to the following (description, area, equipment used): Soil boring and piezometer and monitoring well installation using direct push application methods including MacroCore Sampling and Hollow Stem Auger application and split spoon for sample acquisition.
- II. Required Monitoring Instruments: PID with a 10.6eV Lamp strength
- III. Field Crew: \_\_\_\_\_
- IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector TINUS

**SECTION II: General Safety Requirements (To be filled in by permit issuer)**

- |   |  |
|---|--|
| <p>V. Protective equipment required</p> <p>Level D <input checked="" type="checkbox"/> Level B <input type="checkbox"/><br/>         Level C <input type="checkbox"/> Level A <input type="checkbox"/><br/>         Detailed on Reverse</p> | <p>Respiratory equipment required</p> <p>Full face APR <input type="checkbox"/> Escape Pack <input type="checkbox"/><br/>         Half face APR <input type="checkbox"/> SCBA <input type="checkbox"/><br/>         SAR <input type="checkbox"/> Bottle Trailer <input type="checkbox"/><br/>         Skid Rig <input type="checkbox"/> None <input checked="" type="checkbox"/></p> |
|---|--|

Modifications/Exceptions: Minimum requirements stated below. Upgrade to Level C protection - full-face APR with organic vapor/HEPA cartridges if elevated VOCs are observed in worker breathing zones or dust suppression is unsuccessful. This is not anticipated given the concentration of the contaminants in the soils and given the non-disruptive nature of the sampling systems.

VI. Chemicals of Concern	Action Level(s)	Response Measures
*General Contaminants Classifications	>10ppm/>10 minute duration/4 times/day	Notify PHSO
Dusts and Particulates	>2 mg/m <sup>3</sup> (Visible dust)	Dust Suppression/Area Wetting

**VII. Additional Safety Equipment/Procedures**

- |  |  |
|--|--|
| <p>Hard-hat ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Safety Glasses ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Chemical/splash goggles ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Splash Shield ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Splash suits/coveralls ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Steel toe Work shoes or boots ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Chemical Resistant Boot Covers ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> | <p>Hearing Protection (Plugs/Muffs) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Safety belt/harness ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Radio ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Barricades ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Gloves (Type - Nitrile) ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Work/rest regimen ..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Impermeable apron ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> |
|--|--|

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall, if there is a potential for soiling work clothes. PVC or PE coated Tyvek, if saturation or work clothes may occur. It is recommended that the Driller and the Driller's helper wear impermeable aprons to prevent soiling of work clothes when handling auger flights against the body. This measure can be used in place of the Tyvek or PE or PVC coated Tyvek providing it offers the same level of protection.

- |   |   |
|---|---|
| <p>VIII. Procedure review with permit acceptors</p> <p>Safety shower/eyewash (Location &amp; Use) ..... <input type="checkbox"/> Yes <input type="checkbox"/> NA</p> <p>Procedure for safe job completion ..... <input type="checkbox"/> Yes <input type="checkbox"/> NA</p> <p>Contractor tools/equipment/PPE inspected ..... <input type="checkbox"/> Yes <input type="checkbox"/> NA</p> | <p>Emergency alarms ..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> NA</p> <p>Evacuation routes ..... <input type="checkbox"/> Yes <input type="checkbox"/> NA</p> <p>Assembly points ( ) ..... <input type="checkbox"/> Yes <input type="checkbox"/> NA</p> |
|---|---|

**IX. Site Preparation**

- |   |                          |                          |                          |
|---|--------------------------|--------------------------|--------------------------|
|   | Yes                      | No                       | NA                       |
| Utility Locating and Excavation Clearance completed .....     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Vehicle and Foot Traffic Routes Cleared and Established ..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physical Hazards Barricaded and Isolated .....                | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Emergency Equipment Staged .....                              | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- X. Additional Permits required (Utility Locating and Excavation Clearance – Attachment II) ..... ☒ Yes ☐ No
- If yes, complete permit required or contact Health Sciences, Pittsburgh Office*

XI. Special instructions, precautions: Follow the safe work practices for drilling specified in Section 5.2 of this HASP. Use proper lifting techniques defined in Table 5-1 for mobilization/demobilization. Complete an Equipment Inspection Checklist for the Direct Push and HSA Drill Rig upon arrival to the site, and then every 10 day shift thereafter or after major repairs. Test all emergency stop devices initially then periodically to insure operational status. Decontamination of equipment will consist of soap and water wash and rinse with the use of a pressure washer until visibly clean. Personnel decontamination will consist of disposing of single use PPE and washing hands and face prior to breaks or meals. Many of the materials in question are solids or liquids with elevated boiling points that bind to particulates. The potential for exposure can occur only through mechanical dispersion (inhalation) or hand to mouth contact (ingestion) through poor work hygiene practices. Minimization of these hazards can control potential exposures.

\* - General Contaminant Classifications – Waste/residual oils, Paints (Pigments), Inks, Thinners, and Solvents

Permit Issued by: \_\_\_\_\_ Permit Accepted by: \_\_\_\_\_

**SAFE WORK PERMIT**  
**GEOGRAPHICAL SURVEYING ACTIVITIES**  
**NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

Permit No. \_\_\_\_\_ Date: \_\_\_\_\_ Time: From \_\_\_\_\_ to \_\_\_\_\_

**SECTION I: General Job Scope**

- I. Work limited to the following (description, area, equipment used): Geographical Surveying
- II. Required Monitoring Instruments: None
- III. Field Crew: \_\_\_\_\_
- IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector TINUS

**SECTION II: General Safety Requirements (To be filled in by permit issuer)**

- V. Protective equipment required Respiratory equipment required
- |  |  |  |
|--|--|--|
| Level D <input checked="" type="checkbox"/> Level B <input type="checkbox"/> | Full face APR <input type="checkbox"/> | Escape Pack <input type="checkbox"/>     |
| Level C <input type="checkbox"/> Level A <input type="checkbox"/>            | Half face APR <input type="checkbox"/> | SCBA <input type="checkbox"/>            |
| Detailed on Reverse  | SAR <input type="checkbox"/>           | Bottle Trailer <input type="checkbox"/>  |
|  | Skid Rig <input type="checkbox"/>      | None <input checked="" type="checkbox"/> |

Modifications/Exceptions: None Anticipated. Minimum requirements include sleeved shirt and long pants and safety footwear.(except for magnetometer, geophysical surveys).

VI. Chemicals of Concern	Action Level(s)	Response Measures
<u>None anticipated</u>		

**VII. Additional Safety Equipment/Procedures**

- |                                     |   |  |   |
|-------------------------------------|---|--|---|
| Hard-hat .....                      | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Hearing Protection (Plugs/Muffs) ..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Safety Glasses .....                | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Safety belt/harness .....              | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical/splash goggles .....       | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Radio .....                            | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash Shield .....                 | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Barricades .....                       | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash suits/coveralls .....        | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Gloves (Type - <u>Work</u> ) .....     | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Steel toe Work shoes or boots ..... | <input type="checkbox"/> Yes <input type="checkbox"/> No            | Work/rest regimen .....                | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |

Modifications/Exceptions: Pant legs are to be taped to work boots to prevent entry under the clothing by ticks and other insects when working in heavy brush and wooded areas. Use repellants applied directly to the clothing at all entry points(pants to boots, shirt to pants, etc.) Tyvek coveralls may be used in heavy brush to protect against natural hazards (e.g. ticks) and also to make identification easier. If working in areas where snakes are a threat, wear snake chaps to protect against bites. Surveyors working along highways and traffic pathways shall wear high visibility vests to increase visual recognition.

- VIII. Procedure review with permit acceptors Yes NA
- |  |   |                         |   |
|--|---|-------------------------|---|
| Safety shower/eyewash (Location & Use) .....   | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA | Emergency alarms .....  | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> NA |
| Procedure for safe job completion .....        | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA | Evacuation routes ..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> NA |
| Contractor tools/equipment/PPE inspected ..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA | Assembly points .....   | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> NA |

**IX. Site Preparation**

- |   |   |
|---|---|
| Utility Locating and Excavation Clearance completed .....     | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> NA |
| Vehicle and Foot Traffic Routes Cleared and Established ..... | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> NA |
| Physical Hazards Barricaded and Isolated .....                | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> NA |
| Emergency Equipment Staged .....                              | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> NA |

- X. Additional Permits required (Hot work, confined space entry, excavation etc.) .....
- If yes, complete permit required or contact Health Sciences, Pittsburgh Office
- ☐ Yes ☒ No

XI. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Avoid potential nesting areas. Wear light colored clothing so that ticks and other biting insects can be easily visible and can be removed. Decontamination is not required for this operation, it is however, required that persons perform a close body inspection upon exiting wooded or brush areas for ticks prior to entering vehicles and work trailers, etc.. Natural hazards are not necessarily anticipated unless survey crews need to carry bench marks and control points from or through remote locations. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather. Inspect all hand tools to insure in good condition prior to use (i.e., cutting tools are sharp, handles are free from defects, etc.). When cutting tools are not in use insure they placed in protective sheath. Maintain a ten foot radius around anyone clearing brush using a brush hook or machete.

Permit Issued by: \_\_\_\_\_ Permit Accepted by: \_\_\_\_\_

**ATTACHMENT V**

**MEDICAL DATA SHEET**

## MEDICAL DATA SHEET

This Medical Data Sheet must be completed by all on-site personnel and kept in a central location during the execution of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project NTC Great Lakes, Great Lakes, Illinois CTO 0154

Name \_\_\_\_\_ Home Telephone \_\_\_\_\_

Address \_\_\_\_\_

Age \_\_\_\_\_ Height \_\_\_\_\_ Weight \_\_\_\_\_

Name of Next Kin \_\_\_\_\_

Drug or other Allergies \_\_\_\_\_

Particular Sensitivities \_\_\_\_\_

Do You Wear Contacts? \_\_\_\_\_

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals \_\_\_\_\_

\_\_\_\_\_

What medications are you presently using? \_\_\_\_\_

\_\_\_\_\_

Do you have any medical restrictions? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Name, Address, and Phone Number of personal physician: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

I am the individual described above. I have read and understand this HASP.

\_\_\_\_\_

Signature

\_\_\_\_\_

Date

## **ATTACHMENT VI**

### **HEARING CONSERVATION PROGRAM**



**HEARING CONSERVATION  
TABLE OF CONTENTS**

<b><u>SECTION</u></b>	<b><u>PAGE</u></b>
<b>1.0 PURPOSE .....</b>	<b>1</b>
<b>2.0 SCOPE .....</b>	<b>1</b>
<b>3.0 RESPONSIBILITIES .....</b>	<b>1</b>
<b>4.0 MONITORING AND ESTABLISHING HIGH-NOISE AREAS .....</b>	<b>1</b>
<b>5.0 HEARING PROTECTION .....</b>	<b>2</b>
<b>6.0 TRAINING PROGRAM .....</b>	<b>2</b>
<b>7.0 RECORDKEEPING .....</b>	<b>2</b>
<b>8.0 ATTACHMENT .....</b>	<b>3</b>
<b>8.1 29 CFR 1910.95 Occupational Noise Exposure .....</b>	<b>4</b>

# HEARING CONSERVATION

## 1.0 PURPOSE

To establish general and site-specific hearing conservation procedures and guidelines.

## 2.0 SCOPE

Applies to all hazardous waste and other field activities where exposure to high levels of noise may occur. This program is designed to comply with OSHA General Industry Standard 29 CFR 1910.95.

## 3.0 RESPONSIBILITIES

Project Health and Safety Officer (PHSO) - The PHSO shall ensure that hearing conservation measures are adequately addressed in the Site Specific Health and Safety Plan.

Site Safety Officer (SSO) - The SSO is responsible for establishing and implementing a hearing conservation program. The SSO also ensures that adequate procedures are followed to prevent excessive exposure of individuals to high levels of noise.

Project Manager (PM) - The PM will ensure that sufficient information has been provided to the PHSO to prepare adequate procedures for inclusion in the site-specific Health and Safety Plan (HASP). The PM is also ultimately responsible for the effective compliance with these requirements.

## 4.0 MONITORING AND ESTABLISHING HIGH-NOISE AREAS

4.1 The SSO, as necessary, will perform an initial noise survey on Tetra Tech NUS and Subcontractors operations and work areas by the use of a sound meter and/or dosimetry. All monitoring will be done in accordance with 29 CFR 1910.95. Areas and operations which are expected to reach or exceed 85 decibels (dBA) will be required to adhere to the requirements for this program.

4.2 The HASP will set policy on mandatory use of hearing protection in affected areas, and while performing certain operations. The FOL and/or SSO will notify all Tetra Tech NUS and Subcontractor personnel of high noise areas and operations prior to work initiation.

The FOL and/or the SSO will be responsible for implementation and enforcement of the site-specific Hearing Conservation elements.

- 4.3** The FOL and/or the SSO will post or otherwise identify areas of operations which exceed 85 dBA. If significant changes in noise levels occur (such as a shutdown in an operating unit, change in procedures), the noise levels shall be re-evaluated by the SSO to determine if hearing protection will be worn.

## **5.0 HEARING PROTECTION**

Each employee will have the opportunity to choose from a variety of hearing protection devices. Hearing protectors shall be replaced as necessary. The SSO will evaluate the attenuation factors of hearing protection devices and will select appropriate types based on sound level monitoring or personal dosimetry.

## **6.0 TRAINING PROGRAM**

The Health Sciences Department will institute and maintain an initial training program for new employees and provide an annual training program for employees who may be exposed to noise sources 85 dBA or greater.

The annual training will be incorporated with the refresher health and safety training curricula. All affected employees will be involved in the program and their participation documented.

- 6.1** The training program shall include the effects of noise on hearing. It will also include the purpose of hearing protectors; the advantages, disadvantages, and attenuation factors of the various types. Instruction shall be given on issue points, selection, fitting, use and care of hearing protectors.

- 6.2** A copy of the OSHA Noise Standard and applicable informational and training material will be available to all employees.

## **7.0 RECORDKEEPING**

Exposure measurements, related records will be kept at the site. Record retention will be done in accordance with the time periods stated in 29 CFR 1910.95 and 1910.20.

**8.0 ATTACHMENTS**

**8.1 29 CFR 1910.95 Occupational Noise Exposure**

**8.1.1 Code of Federal Regulations, Subsection 1910.95**

**ATTACHMENT 8.1**

**29 CFR 1910.95 OCCUPATIONAL NOISE EXPOSURE**

<b>Site:</b>		<b>Type of Audio Monitoring Equipment:</b>		<b>Date:</b>
<b>Employee Name</b>	<b>Operation</b>	<b>Hearing Protection Type Attenuation Factor</b>	<b>Noise Levels Measured</b>	<b>Duration of Use</b>

Forward completed table (with backup noise monitoring data) to the Manager, Health Sciences.

# ATTACHMENT 8.1.1

## CODE OF FEDERAL REGULATIONS, SUBSECTION 1910.95

### Occupational Safety and Health Admin., Labor

§ 1910.95

FR 5322, Feb. 10, 1984; 55 FR 32015, Aug. 6, 1990; 58 FR 35308, June 30, 1993]

TABLE G-16—PERMISSIBLE NOISE EXPOSURES<sup>1</sup>

#### § 1910.95 Occupational noise exposure.

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

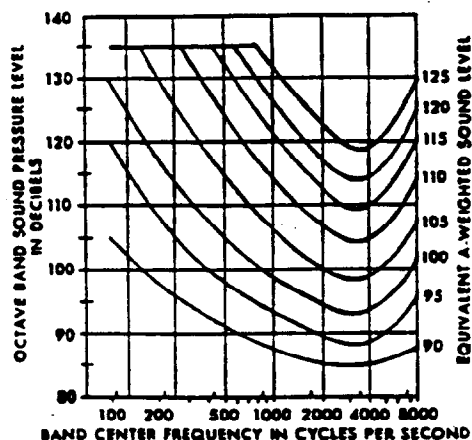


FIGURE G-9

Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table G-16.

(b)(1) When employees are subjected to sound exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of Table G-16, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table.

(2) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
¾	110
½ or less	115

<sup>1</sup> When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions:  $C_1/T_1 + C_2/T_2 + C_3/T_3$ , exceeds unity, then, the mixed exposure should be considered to exceed the limit value.  $C_n$  indicates the total time of exposure at a specified noise level, and  $T_n$  indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

#### (c) Hearing conservation program.

(1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs (c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale (slow response) or, equivalently, a dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with appendix A and Table G-16a, and without regard to any attenuation provided by the use of personal protective equipment.

(2) For purposes of paragraphs (c) through (n) of this section, an 8-hour time-weighted average of 85 decibels or a dose of fifty percent shall also be referred to as the action level.

(d) *Monitoring.* (1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

(i) The sampling strategy shall be designed to identify employees for inclusion in the hearing conservation program and to enable the proper selection of hearing protectors.

(ii) Where circumstances such as high worker mobility, significant variations in sound level, or a significant

§ 1910.95

29 CFR Ch. XVII (7-1-93 Edition)

component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(2)(i) All continuous, intermittent and impulsive sound levels from 80 decibels to 130 decibels shall be integrated into the noise measurements.

(ii) Instruments used to measure employee noise exposure shall be calibrated to ensure measurement accuracy.

(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(i) Additional employees may be exposed at or above the action level; or

(ii) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of paragraph (j) of this section.

(e) *Employee notification.* The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 decibels of the results of the monitoring.

(f) *Observation of monitoring.* The employer shall provide affected employees or their representatives with an opportunity to observe any noise measurements conducted pursuant to this section.

(g) *Audiometric testing program.* (1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation, or who has satisfactorily demonstrated competence in administering audiometric examinations, obtaining valid audiograms, and properly using,

maintaining and checking calibration and proper functioning of the audiometers being used. A technician who operates microprocessor audiometers does not need to be certified. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or physician.

(4) All audiograms obtained pursuant to this section shall meet the requirements of Appendix C: *Audiometric Measuring Instruments.*

(5) *Baseline audiogram.* (i) Within 6 months of an employee's first exposure at or above the action level, the employer shall establish a valid baseline audiogram against which subsequent audiograms can be compared.

(ii) *Mobile test van exception.* Where mobile test vans are used to meet the audiometric testing obligation, the employer shall obtain a valid baseline audiogram within 1 year of an employee's first exposure at or above the action level. Where baseline audiograms are obtained more than 6 months after the employee's first exposure at or above the action level, employees shall wear hearing protectors for any period exceeding six months after first exposure until the baseline audiogram is obtained.

(iii) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise. Hearing protectors may be used as a substitute for the requirement that baseline audiograms be preceded by 14 hours without exposure to workplace noise.

(iv) The employer shall notify employees of the need to avoid high levels of non-occupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(6) *Annual audiogram.* At least annually after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above an 8-hour time-weighted average of 85 decibels.

(7) *Evaluation of audiogram.* (i) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if the audiogram is valid and if a standard threshold shift as defined in paragraph (g)(10) of this section has oc-

Occupational Safety and Health Admin., Labor

§ 1910.95

curred. This comparison may be done by a technician.

(ii) If the annual audiogram shows that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(iii) The audiologist, otolaryngologist, or physician shall review problem audiograms and shall determine whether there is a need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

(A) A copy of the requirements for hearing conservation as set forth in paragraphs (c) through (n) of this section;

(B) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(C) Measurements of background sound pressure levels in the audiometric test room as required in Appendix D: Audiometric Test Rooms.

(D) Records of audiometer calibrations required by paragraph (h)(5) of this section.

(8) *Follow-up procedures.* (i) If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift as defined in paragraph (g)(10) of this section has occurred, the employee shall be informed of this fact in writing, within 21 days of the determination.

(ii) Unless a physician determines that the standard threshold shift is not work related or aggravated by occupational noise exposure, the employer shall ensure that the following steps are taken when a standard threshold shift occurs:

(A) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(B) Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(C) The employee shall be referred for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a

medical pathology of the ear is caused or aggravated by the wearing of hearing protectors.

(D) The employee is informed of the need for an otological examination if a medical pathology of the ear that is unrelated to the use of hearing protectors is suspected.

(iii) If subsequent audiometric testing of an employee whose exposure to noise is less than an 8-hour TWA of 90 decibels indicates that a standard threshold shift is not persistent, the employer:

(A) Shall inform the employee of the new audiometric interpretation; and

(B) May discontinue the required use of hearing protectors for that employee.

(9) *Revised baseline.* An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or physician who is evaluating the audiogram:

(i) The standard threshold shift revealed by the audiogram is persistent; or

(ii) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

(10) *Standard threshold shift.* (i) As used in this section, a standard threshold shift is a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(ii) In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging (presbycusis) to the change in hearing level by correcting the annual audiogram according to the procedure described in Appendix F: *Calculation and Application of Age Correction to Audiograms.*

(h) *Audiometric test requirements.*

(1) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that



§ 1910.95

29 CFR Ch. XVII (7-1-93 Edition)

meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969.

(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in Appendix C: *Audiometric Measuring Instruments*.

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in Appendix D: *Audiometric Test Rooms*.

(5) *Audiometer calibration.* (i) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 decibels or greater require an acoustic calibration.

(ii) Audiometer calibration shall be checked acoustically at least annually in accordance with Appendix E: *Acoustic Calibration of Audiometers*. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check. Deviations of 15 decibels or greater require an exhaustive calibration.

(iii) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this calibration.

(i) *Hearing protectors.* (1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(2) Employers shall ensure that hearing protectors are worn:

(i) By an employee who is required by paragraph (b)(1) of this section to wear personal protective equipment; and

(ii) By any employee who is exposed to an 8-hour time-weighted average of 85 decibels or greater, and who:

(A) Has not yet had a baseline audiogram established pursuant to paragraph (g)(5)(ii); or

(B) Has experienced a standard threshold shift.

(3) Employees shall be given the opportunity to select their hearing protectors from a variety of suitable hearing protectors provided by the employer.

(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

(j) *Hearing protector attenuation.*

(1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used. The employer shall use one of the evaluation methods described in Appendix B: *Methods for Estimating the Adequacy of Hearing Protection Attenuation*.

(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time-weighted average of 90 decibels as required by paragraph (b) of this section.

(3) For employees who have experienced a standard threshold shift, hearing protectors must attenuate employee exposure to an 8-hour time-weighted average of 85 decibels or below.

(4) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

(k) *Training program.* (1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

Occupational Safety and Health Admin., Labor

§ 1910.95

(3) The employer shall ensure that each employee is informed of the following:

(i) The effects of noise on hearing;  
(ii) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and  
(iii) The purpose of audiometric testing, and an explanation of the test procedures.

(1) *Access to information and training materials.* (1) The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to the standard that are supplied to the employer by the Assistant Secretary.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the Assistant Secretary and the Director.

(m) *Recordkeeping—(1) Exposure measurements.* The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(2) *Audiometric tests.* (i) The employer shall retain all employee audiometric test records obtained pursuant to paragraph (g) of this section:

(ii) This record shall include:

(A) Name and job classification of the employee;

(B) Date of the audiogram;

(C) The examiner's name;

(D) Date of the last acoustic or exhaustive calibration of the audiometer; and

(E) Employee's most recent noise exposure assessment.

(F) The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(3) *Record retention.* The employer shall retain records required in this paragraph (m) for at least the following periods.

(i) Noise exposure measurement records shall be retained for two years.

(ii) Audiometric test records shall be retained for the duration of the affected employee's employment.

(4) *Access to records.* All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the Assistant Secretary. The provisions of 29 CFR 1910.20 (a)-(e) and (g)-(i) apply to access to records under this section.

(5) *Transfer of records.* If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in paragraph (m) (3) of this section.

(n) *Appendices.* (1) Appendices A, B, C, D, and E to this section are incorporated as part of this section and the contents of these appendices are mandatory.

(2) Appendices F and G to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

(o) *Exemptions.* Paragraphs (c) through (n) of this section shall not apply to employers engaged in oil and gas well drilling and servicing operations.

(p) *Startup date.* Baseline audiograms required by paragraph (g) of this section shall be completed by March 1, 1984.

(Approved by the Office of Management and Budget under control number 1218-0048)

APPENDIX A TO § 1910.95—NOISE EXPOSURE COMPUTATION

*This Appendix is Mandatory*

I. Computation of Employee Noise Exposure

(1) Noise dose is computed using Table G-16a as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by:  $D = 100 C/T$  where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table G-16a or by the formula shown as a footnote to that table.

§ 1910.95

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by:

$$D = 100 (C_1/T_1 + C_2/T_2 + \dots + C_n/T_n)$$

where  $C_n$  indicates the total time of exposure at a specific noise level, and  $T_n$  indicates the reference duration for that level as given by Table G-16a.

(2) The eight-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula:  $TWA = 16.61 \log_{10} (D/100) + 90$ . For an eight-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(3) A table relating dose and TWA is given in Section II.

TABLE G-16a

A-weighted sound level, L (decibel)	Reference duration, T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.1
93	5.3
94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.3
104	1.1
105	1
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.096
123	0.082

29 CFR Ch. XVII (7-1-93 Edition)

TABLE G-16a—Continued

A-weighted sound level, L (decibel)	Reference duration, T (hour)
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031

In the above table the reference duration, T, is computed by

$$T = \frac{8}{2^{(L-90)/10}}$$

where L is the measured A-weighted sound level.

II. Conversion Between "Dose" and "8-Hour Time-Weighted Average" Sound Level

Compliance with paragraphs (c)-(f) of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." In order to better understand the requirements of the amendment, dosimeter readings can be converted to an "8-hour time-weighted average sound level." (TWA).

In order to convert the reading of a dosimeter into TWA, see Table A-1, below. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table G-16a. So, for example, a dose of 91 percent over an eight hour day results in a TWA of 89.3 dB, and, a dose of 50 percent corresponds to a TWA of 85 dB.

If the dose as read on the dosimeter is less than or greater than the values found in Table A-1, the TWA may be calculated by using the formula:  $TWA = 16.61 \log_{10} (D/100) + 90$  where TWA=8-hour time-weighted average sound level and D=accumulated dose in percent exposure.

ATTACHMENT 8.1.1  
CODE OF FEDERAL REGULATIONS, SUBSECTION 1910.95  
PAGE SEVEN

Occupational Safety and Health Admin., Labor

§ 1910.95

TABLE A-1—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)

Dose or percent noise exposure	TWA
10	73.4
15	75.3
20	76.4
25	78.0
30	81.3
35	82.4
40	83.4
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6
83	88.7
84	88.8
85	88.9
86	89.0
87	89.1
88	89.2
89	89.2
90	89.3
91	89.4
92	89.5
93	89.6
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0

TABLE A-1—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)—Continued

Dose or percent noise exposure	TWA
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1

§ 1910.95

29 CFR Ch. XVII (7-1-93 Edition)

TABLE A-1—CONVERSION FROM "PERCENT NOISE EXPOSURE" OR "DOSE" TO "8-HOUR TIME-WEIGHTED AVERAGE SOUND LEVEL" (TWA)—Continued

Dose or percent noise exposure	TWA
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
995	106.6

APPENDIX B TO § 1910.95—METHODS FOR ESTIMATING THE ADEQUACY OF HEARING PROTECTOR ATTENUATION

*This Appendix is Mandatory*

For employees who have experienced a significant threshold shift, hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dB. Employers must select one of the following methods by which to estimate the adequacy of hearing protector attenuation.

The most convenient method is the Noise Reduction Rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This appendix describes four methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection among the four procedures is dependent upon the employer's noise measuring instruments.

Instead of using the NRR, employers may evaluate the adequacy of hearing protector attenuation by using one of the three methods developed by the National Institute for Occupational Safety and Health (NIOSH), which are described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37. These methods are known as NIOSH methods #1, #2 and #3. The NRR described below is a simplification of NIOSH method

#2. The most complex method is NIOSH method #1, which is probably the most accurate method since it uses the largest amount of spectral information from the individual employee's noise environment. As in the case of the NRR method described below, if one of the NIOSH methods is used, the selected method must be applied to an individual's noise environment to assess the adequacy of the attenuation. Employers should be careful to take a sufficient number of measurements in order to achieve a representative sample for each time segment.

**NOTE:** The employer must remember that calculated attenuation values reflect realistic values only to the extent that the protectors are properly fitted and worn.

When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

(i) When using a dosimeter that is capable of C-weighted measurements:

(A) Obtain the employee's C-weighted dose for the entire workshift, and convert to TWA (see appendix A, II).

(B) Subtract the NRR from the C-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(ii) When using a dosimeter that is not capable of C-weighted measurements, the following method may be used:

(A) Convert the A-weighted dose to TWA (see appendix A).

(B) Subtract 7 dB from the NRR.

(C) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iii) When using a sound level meter set to the A-weighting network:

(A) Obtain the employee's A-weighted TWA.

(B) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(iv) When using a sound level meter set on the C-weighting network:

(A) Obtain a representative sample of the C-weighted sound levels in the employee's environment.

(B) Subtract the NRR from the C-weighted average sound level to obtain the estimated A-weighted TWA under the ear protector.

(v) When using area monitoring procedures and a sound level meter set to the A-weighting network:

(A) Obtain a representative sound level for the area in question.

(B) Subtract 7 dB from the NRR and subtract the remainder from the A-weighted sound level for that area.

Occupational Safety and Health Admin., Labor

§ 1910.95

(vi) When using area monitoring procedures and a sound level meter set to the C-weighting network:

(A) Obtain a representative sound level for the area in question.

(B) Subtract the NRR from the C-weighted sound level for that area.

APPENDIX C TO § 1910.95—AUDIOMETRIC MEASURING INSTRUMENTS

*This Appendix is Mandatory*

1. In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

2. Self-recording audiometers shall comply with the following requirements:

(A) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least  $\frac{1}{4}$  inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(B) It shall be possible to set the stylus manually at the 10-dB increment lines for calibration purposes.

(C) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(D) The audiometer shall remain at each required test frequency for 30 seconds ( $\pm 3$  seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than  $\pm 3$  seconds.

(E) It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at that test frequency. At each test frequency the threshold shall be the average of the mid-points of the tracing excursions.

APPENDIX D TO § 1910.95—AUDIOMETRIC TEST ROOMS

*This Appendix is Mandatory*

Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table D-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

TABLE D-1—MAXIMUM ALLOWABLE OCTAVE-BAND SOUND PRESSURE LEVELS FOR AUDIO-METRIC TEST ROOMS

Octave-band center frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	57	62

APPENDIX E TO § 1910.95—ACOUSTIC CALIBRATION OF AUDIOMETERS

*This Appendix is Mandatory*

Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerances permitted by American Standard Specification for Audiometers, S3.6-1969.

(1) Sound Pressure Output Check

A. Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

B. Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

C. Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.

D. At each frequency the readout on the sound level meter should correspond to the levels in Table E-1 or Table E-2, as appropriate, for the type of earphone, in the column entitled "sound level meter reading."

(2) Linearity Check

A. With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.

B. Measure the sound levels in the coupler at each 10-dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

C. For each 10-dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.

D. This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) Tolerances

When any of the measured sound levels deviate from the levels in Table E-1 or Table E-2 by  $\pm 3$  dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is required.

§ 1910.95

29 CFR Ch. XVII (7-1-93 Edition)

tion is advised. An exhaustive calibration is required if the deviations are greater than 15 dB or greater at any test frequency.

TABLE E-1—REFERENCE THRESHOLD LEVELS  
FOR TELEPHONICS—TDH-39 EARPHONES

Frequency, Hz	Reference threshold level for TDH-39 ear- phones, dB	Sound level meter reading, dB
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	8.5	78.5
6000	15.5	85.5

TABLE E-2—REFERENCE THRESHOLD LEVELS  
FOR TELEPHONICS—TDH-49 EARPHONES

Frequency, Hz	Refer- ence threshold level for TDH-49 ear- phones, dB	Sound level meter reading, dB
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	8.5	78.5
4000	10.5	80.5
6000	13.5	83.5

APPENDIX F TO § 1910.95—CALCULATIONS AND  
APPLICATION OF AGE CORRECTIONS TO AU-  
DIOGRAMS

*This Appendix Is Non-Mandatory*

In determining whether a standard threshold shift has occurred, allowance may be made for the contribution of aging to the change in hearing level by adjusting the most recent audiogram. If the employer chooses to adjust the audiogram, the employer shall follow the procedure described below. This procedure and the age correction tables were developed by the National Institute for Occupational Safety and Health in the criteria document entitled "Criteria for a Recommended Standard . . . Occupational Exposure to Noise," (HSM-11001).

For each audiometric test frequency:

(i) Determine from Tables F-1 or F-2 the age correction values for the employee by:

(A) Finding the age at which the most recent audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz;

(B) Finding the age at which the baseline audiogram was taken and recording the corresponding values of age corrections at 1000 Hz through 6000 Hz.

(ii) Subtract the values found in step (i)(B) from the value found in step (i)(A).

(iii) The differences calculated in step (ii) represented that portion of the change in hearing that may be due to aging.

EXAMPLE: Employee is a 32-year-old male. The audiometric history for his right ear is shown in decibels below.

Employee's age	Audiometric test frequency (Hz)				
	1000	2000	3000	4000	6000
26	10	5	5	10	5
*27	0	0	0	5	5
28	0	0	0	10	5
29	5	0	5	15	5
30	0	5	10	20	10
31	5	10	20	15	15
*32	5	10	10	25	20

The audiogram at age 27 is considered the baseline since it shows the best hearing threshold levels. Asterisks have been used to identify the baseline and most recent audiogram. A threshold shift of 20 dB exists at 4000 Hz between the audiograms taken at ages 27 and 32.

(The threshold shift is computed by subtracting the hearing threshold at age 27, which was 5, from the hearing threshold at age 32, which is 25). A retest audiogram has confirmed this shift. The contribution of aging to this change in hearing may be estimated in the following manner:

Go to Table F-1 and find the age correction values (in dB) for 4000 Hz at age 27 and age 32.

	Frequency (Hz)				
	1000	2000	3000	4000	6000
Age 32	6	5	7	10	14
Age 27	5	4	6	7	11
Difference	1	1	1	3	3

The difference represents the amount of hearing loss that may be attributed to aging in the time period between the baseline audiogram and the most recent audiogram. In this example, the difference at 4000 Hz is 3 dB. This value is subtracted from the hearing level at 4000 Hz, which in the most recent audiogram is 25, yielding 22 after adjustment. Then the hearing threshold in the baseline audiogram at 4000 Hz (5) is subtracted from the adjusted annual audio-

Occupational Safety and Health Admin., Labor

§ 1910.95

gram hearing threshold at 4000 Hz (22). Thus the age-corrected threshold shift would be 17 dB (as opposed to a threshold shift of 20 dB without age correction).

TABLE F-1—AGE CORRECTION VALUES IN DECIBELS FOR MALES

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger	5	3	4	5	8
21	5	3	4	5	8
22	5	3	4	5	8
23	5	3	4	6	9
24	5	3	5	6	9
25	5	3	5	7	10
26	5	4	5	7	10
27	5	4	6	7	11
28	6	4	6	8	11
29	6	4	6	8	12
30	6	4	6	9	12
31	6	4	7	9	13
32	6	5	7	10	14
33	6	5	7	10	14
34	6	5	8	11	15
35	7	5	8	11	15
36	7	5	9	12	16
37	7	6	9	12	17
38	7	6	9	13	17
39	7	6	10	14	18
40	7	6	10	14	19
41	7	6	10	14	20
42	8	7	11	16	20
43	8	7	12	16	21
44	8	7	12	17	22
45	8	7	13	18	23
46	8	8	13	19	24
47	8	8	14	19	24
48	9	8	14	20	25
49	9	9	15	21	26
50	9	9	16	22	27
51	9	9	16	23	28
52	9	10	17	24	29
53	9	10	18	25	30
54	10	10	18	26	31
55	10	11	19	27	32
56	10	11	20	28	34
57	10	11	21	29	35
58	10	12	22	31	36
59	11	12	22	32	37
60 or older	11	13	23	33	38

TABLE F-2—AGE CORRECTION VALUES IN DECIBELS FOR FEMALES

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
20 or younger	7	4	3	3	6
21	7	4	4	3	6
22	7	4	4	4	6
23	7	5	4	4	7
24	7	5	4	4	7
25	8	5	4	4	7
26	8	5	5	4	8
27	8	5	5	5	8
28	8	5	5	5	8
29	8	5	5	5	9

TABLE F-2—AGE CORRECTION VALUES IN DECIBELS FOR FEMALES—Continued

Years	Audiometric Test Frequencies (Hz)				
	1000	2000	3000	4000	6000
30	8	6	5	5	9
31	8	6	6	5	9
32	8	6	6	6	10
33	8	6	6	6	10
34	8	6	6	6	10
35	8	6	7	7	11
36	8	7	7	7	11
37	9	7	7	7	12
38	10	7	7	7	12
39	10	7	8	8	12
40	10	7	8	8	13
41	10	8	8	8	13
42	10	8	8	9	13
43	11	8	9	9	14
44	11	8	9	9	14
45	11	8	10	10	15
46	11	9	10	10	15
47	11	9	10	11	16
48	12	9	11	11	16
49	12	9	11	11	16
50	12	10	11	12	17
51	12	10	12	12	17
52	12	10	12	13	18
53	13	10	13	13	18
54	13	11	13	14	19
55	13	11	14	14	19
56	13	11	14	15	20
57	13	11	15	15	20
58	14	12	15	16	21
59	14	12	16	16	21
60 or older	14	12	16	17	22

APPENDIX G TO § 1910.95—MONITORING NOISE LEVELS NON-MANDATORY INFORMATIONAL APPENDIX

This appendix provides information to help employers comply with the noise monitoring obligations that are part of the hearing conservation amendment.

WHAT IS THE PURPOSE OF NOISE MONITORING?

This revised amendment requires that employees be placed in a hearing conservation program if they are exposed to average noise levels of 85 dB or greater during an 8 hour workday. In order to determine if exposures are at or above this level, it may be necessary to measure or monitor the actual noise levels in the workplace and to estimate the noise exposure or "dose" received by employees during the workday.

WHEN IS IT NECESSARY TO IMPLEMENT A NOISE MONITORING PROGRAM?

It is not necessary for every employer to measure workplace noise. Noise monitoring or measuring must be conducted only when exposures are at or above 85 dB. Factors which suggest that noise exposures in the workplace may be at this level include employee complaints about the loudness of noise, indications that employees are losing



§ 1910.95

29 CFR Ch. XVII (7-1-93 Edition)

their hearing, or noisy conditions which make normal conversation difficult. The employer should also consider any information available regarding noise emitted from specific machines. In addition, actual workplace noise measurements can suggest whether or not a monitoring program should be initiated.

**How is NOISE MEASURED?**

Basically, there are two different instruments to measure noise exposures: the sound level meter and the dosimeter. A sound level meter is a device that measures the intensity of sound at a given moment. Since sound level meters provide a measure of sound intensity at only one point in time, it is generally necessary to take a number of measurements at different times during the day to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

To estimate employee noise exposures with a sound level meter it is also generally necessary to take several measurements at different locations within the workplace. After appropriate sound level meter readings are obtained, people sometimes draw "maps" of the sound levels within different areas of the workplace. By using a sound level "map" and information on employee locations throughout the day, estimates of individual exposure levels can be developed. This measurement method is generally referred to as area noise monitoring.

A dosimeter is like a sound level meter except that it stores sound level measurements and integrates these measurements over time, providing an average noise exposure reading for a given period of time, such as an 8-hour workday. With a dosimeter, a microphone is attached to the employee's clothing and the exposure measurement is simply read at the end of the desired time period. A reader may be used to read-out the dosimeter's measurements. Since the dosimeter is worn by the employee, it measures noise levels in those locations in which the employee travels. A sound level meter can also be positioned within the immediate vicinity of the exposed worker to obtain an individual exposure estimate. Such procedures are generally referred to as personal noise monitoring.

Area monitoring can be used to estimate noise exposure when the noise levels are relatively constant and employees are not mobile. In workplaces where employees move about in different areas or where the noise intensity tends to fluctuate over time, noise exposure is generally more accurately estimated by the personal monitoring approach.

In situations where personal monitoring is appropriate, proper positioning of the microphone is necessary to obtain accurate measurements. With a dosimeter, the microphone is generally located on the shoulder and remains in that position for the entire workday. With a sound level meter, the microphone is stationed near the employee's head, and the instrument is usually held by an individual who follows the employee as he or she moves about.

Manufacturer's instructions, contained in dosimeter and sound level meter operating manuals, should be followed for calibration and maintenance. To ensure accurate results, it is considered good professional practice to calibrate instruments before and after each use.

**How often is it necessary to monitor noise levels?**

The amendment requires that when there are significant changes in machinery or production processes that may result in increased noise levels, remonitoring must be conducted to determine whether additional employees need to be included in the hearing conservation program. Many companies choose to remonitor periodically (once every year or two) to ensure that all exposed employees are included in their hearing conservation programs.

**Where can equipment and technical advice be obtained?**

Noise monitoring equipment may be either purchased or rented. Sound level meters cost about \$500 to \$1,000, while dosimeters range in price from about \$750 to \$1,500. Smaller companies may find it more economical to rent equipment rather than to purchase it. Names of equipment suppliers may be found in the telephone book (Yellow Pages) under headings such as: "Safety Equipment," "Industrial Hygiene," or "Engineers-Acoustical." In addition to providing information on obtaining noise monitoring equipment, many companies and individuals included under such listings can provide professional advice on how to conduct a valid noise monitoring program. Some audiological testing firms and industrial hygiene firms also provide noise monitoring services. Universities with audiology, industrial hygiene, or acoustical engineering departments may also provide information or may be able to help employers meet their obligations under this amendment.

Free, on-site assistance may be obtained from OSHA-supported state and private consultation organizations. These safety and health consultative entities generally give priority to the needs of small businesses. See the attached directory for a listing of organizations to contact for aid.

Occupational Safety and Health Admin., Labor

§ 1910.95

OSHA ONSITE CONSULTATION PROJECT DIRECTORY

State	Office and address	Contact
Alabama	Alabama Consultation Program, P.O. Box 8006, University, Alabama 36488.	(205) 348-7136, Mr. Wilam Weems, Director.
Alaska	State of Alaska, Department of Labor, Occupational Safety & Health, 3301 Eagle St., Pouch 7-022, Anchorage, Alaska 99510.	(907) 276-8013, Mr. Stan Goddard, Project Manager (Air Mail).
American Samoa	Service not yet available.	
Arizona	Consultation and Training, Arizona Division of Occupational Safety and Health, P.O. Box 18070, 1634 W. Adams, Phoenix, AZ 85006.	(602) 255-5795, Mr. Thomas Ramsey, Manager.
Arkansas	OSHA Consultation, Arkansas Department of Labor, 1022 High St., Little Rock, Ark. 72202.	(501) 371-2982, Mr. George Smith, Project Director.
California	CAL/OSHA Consultation Service, 2nd Floor, 525 Golden Gate Avenue, San Francisco, CA 94102.	(415) 557-2670, Mr. Emmett Jones, Chief.
Colorado	Occupational Safety & Health Section, Colorado State University, Institute of Rural Environmental Health, 110 Veterinary Science Building, Fort Collins, CO 80523.	(303) 481-8151, Dr. Roy M. Buchan, Project Director.
Connecticut	Division of Occupational Safety & Health, Connecticut Department of Labor, 300 Folly Brook Boulevard, Wethersfield, Conn. 06109.	(203) 566-4550, Mr. Leo Alor, Director.
Delaware	Delaware Department of Labor, Division of Industrial Affairs, 820 North French Street, 6th Floor, Wilmington, DE 19801.	(302) 571-3808, Mr. Bruno Salvador, Director.
District of Columbia	Occupational Safety & Health Division, District of Columbia, Department Employment Services, Office of Labor Standards, 2900 Newton Street NE, Washington, DC 20018.	(202) 832-1230, Mr. Lorenzo M. White, Acting Associate Director.
Florida	Department of Labor & Employment Security, Bureau of Industrial Safety and Health, LaFayette Building, Room 204, 2551 Executive Center Circle West, Tallahassee, FL 32301.	(904) 488-2044, Mr. John C. Glenn, Administrator.
Georgia	Economic Development Division, Technology and Development Laboratory, Engineering Experiment Station, Georgia Institute of Technology, Atlanta, GA 30332.	(404) 894-3806, Mr. Wilam C. Howard, Assistant to Director, Mr. James Burson, Project Manager.
Guam	Department of Labor, Government of Guam, 23548 Guam Main Facility, Agaña, Guam 96821.	(671) 772-6291, Joe R. San Agustin, Director.
Hawaii	Education and Information Branch, Division of Occupational Safety and Health, Suite 910, 677 Ala Moana, Honolulu, HI 96813.	(808) 548-2511, Mr. Don Alper, Manager (Air Mail).
Idaho	OSHA Onsite Consultation Program, Boise State University, Community and Environmental Health, 1910 University Drive, Boise, ID 83725.	(208) 385-3829, Dr. Eldon Edmundson, Director.
Illinois	Division of Industrial Services, Dept. of Commerce and Community Affairs, 310 S. Michigan Avenue, 10 Floor, Chicago, IL 60601.	(800) 972-4140/4216 (Toll-free in State), (312) 793-3270, Mr. Stan Chwinski, Assistant Director.
Iowa	Bureau of Labor, 307 E. Seventh Street, Des Moines, IA 50319.	(515) 281-3606, Mr. Allen J. Meier, Commissioner.
Indiana	Bureau of Safety, Education and Training, Indiana Division of Labor, 1013 State Office Building, Indianapolis, IN 46204.	(317) 633-5845, Mr. Harold Mills, Director.
Kansas	Kansas Dept. of Human Resources, 401 Topeka Ave., Topeka, KS 66603.	(913) 296-4086, Mr. Jerry Abbott, Secretary.
Kentucky	Education and Training, Occupational Safety and Health, Kentucky Department of Labor, 127 Building, 127 South, Frankfort, KY 40601.	(502) 564-6885, Mr. Larry Potter, Director.
Louisiana	No services available as yet (Pending FY 83).	
Maine	Division of Industrial Safety, Maine Dept. of Labor, Labor Station 45, State Office Building, Augusta, ME 04333.	(207) 298-3331, Mr. Lester Wood, Director.
Maryland	Consultation Service, Division of Labor & Industry, 501 St. Paul Place, Baltimore, Maryland 21202.	(301) 658-4210, Ms. Keana O'Brien, Project Manager, 7(c)(1) Agreement.
Massachusetts	Division of Industrial Safety, Massachusetts Department of Labor and Industries, 100 Cambridge Street, Boston, MA 02202.	(617) 727-3567, Mr. Edward Noseworthy, Project Director.

ATTACHMENT 8.1.1  
CODE OF FEDERAL REGULATIONS, SUBSECTION 1910.95  
PAGE FOURTEEN

§ 1910.95

29 CFR Ch. XVII (7-1-93 Edition)

OSHA ONSITE CONSULTATION PROJECT DIRECTORY—Continued

State	Office and address	Contact
Michigan (Health)	Special Programs Section, Division of Occupational Health, Michigan Dept. of Public Health, 3500 N. Logan, Lansing, MI 48908.	(517) 373-1410, Mr. Irving Davis, Chief.
Michigan (Safety)	Safety Education & Training Division Bureau of Safety and Regulation, Michigan Department of Labor, 7150 Harris Drive, Box 30015, Lansing, Michigan 48908.	(517) 322-1809, Mr. Alan Harve, Chief.
Minnesota	Training and Education Unit, Department of Labor and Industry, 8th Floor, 444 Lafayette Road, St. Paul, MN 55101.	(612) 296-2973, Mr. Timothy Turney, Project Manager.
Mississippi	Division of Occupational Safety and Health, Mississippi State Board of Health, P.O. Box 1700, Jackson, MS 39208.	(601) 982-8315, Mr. Henry L. Laird, Director.
Missouri	Missouri Department of Labor and Industrial Relations, 722 Jefferson Street, Jefferson City, MO 65101.	1-(800) 382-0208, (314) 781-3403, Ms. Paula Smith, Mr. Jim Brake.
Montana	Montana Bureau of Safety & Health, Division of Workers Compensation, 815 Front Street, Helena, MT 59601.	(406) 449-3402, Mr. Ed Getzmeier, Chief.
Nebraska	Nebraska Department of Labor, State House Station, State Capitol, P.O. Box 94800, Lincoln, NE 68508.	475-8451 Ext. 258, Mr. Joseph Carrell, Commissioner.
Nevada	Department of Occupational Safety and Health, Nevada Industrial Commission, 515 E. Muffler Street, Carson City, NV 89714.	(702) 865-5240, Mr. Allen Trautner, Director.
New Hampshire	For information contact	Office of Consultation Programs, Room N3472, 200 Constitution Avenue, NW, Washington, DC 20210, Phone: (202) 523-8885.
New Jersey	New Jersey Department of Labor and Industry Division of Work Place Standards, CN-054, Trenton, NJ 08625.	(609) 292-2313, FTS-8-477-2313, Mr. William Clark, Assistant Commissioner.
New Mexico	OSHA Consultation, Health and Environment Department, Environmental Improvement Division, Occupational Health & Safety Section, 4215 Montgomery Boulevard, NE, Albuquerque, NM 87109.	(505) 842-3367, Mr. Albert M. Stevens, Project Manager.
New York	Division of Safety and Health, New York State Department of Labor, 2 World Trade Center, Room 8885, New York, NY 10047.	(212) 486-7748/7, Mr. Joseph Allens, Project Manager, DOSH.
North Carolina	Consultation Services, North Carolina Department of Labor, 4 West Edmon Street, Raleigh, NC 27601.	(919) 733-4885, Mr. David Pierce, Director.
North Dakota	Division of Environmental Research, Department of Health, Missouri Office Building, 1200 Missouri Avenue, Bismarck, ND 58505.	(701) 224-2348, Mr. Jay Crawford, Director.
Ohio	Department of Industrial Relations, Division of Onsite Consultation, P.O. Box 825, 2323 6th Avenue, Columbus, OH 43216.	(800) 282-1425 (Toll-free in State), (614) 466-7485, Mr. Andrew Doshval, Project Manager.
Oklahoma	OSHA Division, Oklahoma Department of Labor, State Capitol, Suite 118, Oklahoma City, OK 73105.	(405) 521-2461, Mr. Charles W. McGinn, Director.
Oregon	Consultative Section, Department of Workers' Compensation, Accident Prevention Division, Room 102, Building 1, 2110 Front Street NE, Salem, OR 97310.	(503) 378-2880, Mr. Jack Buckland, Supervisor.
Pennsylvania	For information contact	Office of Consultation Programs, Room N3472, 200 Constitution Avenue NW, Washington, DC 20210, Phone: (202) 523-8885.
Puerto Rico	Occupational Safety & Health, Puerto Rico Department of Labor and Human Resources, 505 Maroz Rivera Ave., 21st Floor, Hato Rey, Puerto Rico 00918.	(808) 764-2134, Mr. John Cinque, Assistant Secretary, (Air Mail).
Rhode Island	Division of Occupational Health, Rhode Island Department of Health, The Cannon Building, 208 Health Department Building, Providence, RI 02903.	(401) 277-2438, Mr. James E. Hickey, Chief.

ATTACHMENT 8.1.1  
CODE OF FEDERAL REGULATIONS, SUBSECTION 1910.95  
PAGE FIFTEEN

Occupational Safety and Health Admin., Labor

§ 1910.95

OSHA ONSITE CONSULTATION PROJECT DIRECTORY—Continued

State	Office and address	Contact
South Carolina	Consultation and Monitoring, South Carolina Department of Labor, P.O. Box 11329, Columbia, SC 29211.	(803) 758-8821, Mr. Robert Peck, Director, 7(C)(1), Project.
South Dakota	South Dakota Consultation Program, South Dakota State University, S.T.A.T.E.-Engineering Extension, 201 Pugsley Center-SDSO, Brookings, SD 57007.	(605) 688-4101, Mr. James Ceglan, Director.
Tennessee	OSHA Consultative Services, Tennessee Department of Labor, 2nd Floor, 501 Union Building, Nashville, TN 37218.	(615) 741-2783, Mr. L. H. Craig Director.
Texas	Division of Occupational Safety and State Safety Engineer, Texas Department of Health and Resources, 1100 West 48th Street, Austin, TX 78758.	(512) 458-7267, Mr. Walter G. Martin, P.E. Director.
Trust Territories	Service not yet available.	
Utah	Utah Job Safety and Health Consultation Service, Suite 4004, Crane Building, 307 West 200 South, Salt Lake City, UT 84101.	(801) 533-7827/8/9, Mr. H. M. Bergeson, Project Director.
Vermont	Division of Occupational Safety and Health, Vermont Department of Labor and Industry, 118 State Street, Montpelier, VT 05602.	(802) 828-2765, Mr. Robert McLeod, Project Director.
Virginia	Department of Labor and Industry, P.O. Box 12084, 205 N. 4th Street, Richmond, Va. 23241.	(804) 786-5875, Mr. Robert Beard, Commissioner.
Virgin Islands	Division of Occupational Safety and Health, Virgin Islands Department of Labor, Lagoon Street, Room 207, Frederiksted, Virgin Islands 00840.	(809) 772-1315, Mr. Louis Llanos, Deputy Director-DOSH.
Washington	Department of Labor and Industry, P.O. Box 207, Olympia, WA 98504.	(206) 753-6500, Mr. James Sullivan, Assistant Director.
West Virginia	West Virginia Department of Labor, Room 4518, State Capitol, 1800 Washington Street, Charleston, WV 25305.	FTS 8-885-7880, Mr. Lawrence Barker, Commissioner.
Wisconsin (Health)	Section of Occupational Health, Department of Health and Social Services, P.O. Box 309, Madison, WI 53701.	(608) 266-0417, Ms. Patricia Natzke, Acting Chief.
Wisconsin (Safety)	Division of Safety and Buildings, Department of Industry, Labor and Human Relations, 1570 E. Moreland Blvd., Waukegan, WI 53186.	(414) 544-8885, Mr. Richard Michalski, Supervisor.
Wyoming	Wyoming Occupational Health and Safety Department, 200 East 8th Avenue, Cheyenne, Wyo. 82002.	(307) 777-7786, Mr. Donald Owsley, Health and Safety Administrator.

APPENDIX H TO § 1910.95—AVAILABILITY OF REFERENCED DOCUMENTS

Paragraphs (c) through (e) of 29 CFR 1910.95 and the accompanying appendices contain provisions which incorporate publications by reference. Generally, the publications provide criteria for instruments to be used in monitoring and audiometric testing. These criteria are intended to be mandatory when so indicated in the applicable paragraphs of § 1910.95 and appendices.

It should be noted that OSHA does not require that employers purchase a copy of the referenced publications. Employers, however, may desire to obtain a copy of the referenced publications for their own information.

The designation of the paragraph of the standard in which the referenced publications appear, the titles of the publications, and the availability of the publications are as follows:

Paragraph designation	Referenced publication	Available from—
Appendix B	"List of Personal Hearing Protectors and Attenuation Data," NIOSH Pub. No. 78-120, 1978. NIOSH-PB287481.	National Technical Information Service, Port Royal Road, Springfield, VA 22161.
Appendix D	"Specification for Sound Level Meters," S1.4-1971 (R1978).	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.
§ 1910.95(c)(2), appendix E	"Specifications for Audiometers," S3.6-1969.	American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

**ATTACHMENT VII**

**FIRE EXTINGUISHER  
USE AND INSPECTION**

## **FIRE EXTINGUISHER**

### **USE AND INSPECTION**

Fire Extinguisher Use and Inspection procedures will be conducted in support of the activities to be conducted at NTC Great Lakes, Great Lakes, Illinois. The following text is intended to provide general instruction to the field personnel charged with this responsibility.

#### **Fire Extinguisher Use**

All personnel trained in incidental response measures may be required to use and operate a fire extinguisher in response to an incipient stage fire. Therefore, the following instruction is provided and will be conveyed to all field personnel as part of site-specific training.

To use a portable fire extinguisher, the user should be familiar with the operation of the specific fire extinguisher located in the workplace. The following procedure will properly extinguish a small fire.

- 1) IDENTIFY THE TYPE OF FIRE (CLASS A, B, C, D).

### CLASSES OF FIRE/FIRE EXTINGUISHER IDENTIFICATION

Fire is divided into four classes for easy identification and extinguishment. The type of fuel or ignition source will determine the type of extinguishing medium required.

**Class A** - Ordinary combustibles (wood, paper, rubber, plastic, and cloth). Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle is green.



**Class B** - Flammable liquids, gases, and greases. Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square is red. This type of extinguisher is effective on small petroleum product fires.



**Class C** - Electrically energized systems. Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the circle is blue.



**Class D** - Combustible metals (sodium, magnesium, phosphorus). Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star is yellow.



**Note:** Water and other extinguishing media, such as carbon dioxide and dry chemicals, are ineffective on metal fires.

## New NFPA Markings



Class A, B, C

Class B, C

Class A, B

Class A

Multi-class (ABC) Fire extinguishers will be provided for use on site. If you will buy a Fire Extinguisher, this is the type recommended. Size or rating recommended is 2 1/2 to 5 lbs.

1. Determine whether the extinguisher is adequate for this fire.

Rating number – The rating number assigned to a fire extinguisher is based on the capabilities of that fire class, for example

Class 5 A – Will provide extinguishing capabilities equal to that of 5 gallons of water.

Class 20 B - Will provide extinguishing capabilities equal to 20 square feet of flammable liquid burning.

Class C & D are not rated as to their limitations.

2. If adequate, hold the extinguisher upright and pull the ring pin.
3. Stand back 10 feet and aim at base of fire. Be careful not to spread burning material with pressurized extinguishing material.
4. Squeeze lever; sweep extinguisher in a side-to-side motion.



## **Portable Fire Extinguisher Placement/Mounting**

Portable Fire Extinguishers will be placed/mounted in clear view in the areas where flammable materials are stored and/or dispensed. Mounting and placement of fire extinguishers will follow the following requirements

### **Fixed Locations (Flammable Storage)**

- Extinguisher location will be marked by a red painted post to indicate extinguisher location
- The travel distance to access a fire extinguisher shall be no greater than 50 feet.
- The fire extinguisher will be mounted at a maximum height of four feet.

### **Mobile Locations (Drill Rigs, Support Vehicles)**

All vehicles carrying fuel containers or used in the dispensing of fuel will carry at a minimum a 5 pound rated fire extinguisher.

## **Portable Fire Extinguisher Inspection**

All fire extinguishers used in support of this field effort will be inspected on the following frequencies:

- A certified provider will perform maintenance checks of fire extinguishers at least once a year. A tag attached to the neck of the fire extinguisher will indicate documentation of the maintenance check.
- All fire extinguishers will have a current hydrostatic inspection. For the type of extinguishers selected for use at NTC Great Lakes, hydrostatic inspections are required every 5 years.
- All fire extinguishers will be inspected monthly. The monthly inspection will cover the following
  - Are the fire extinguisher(s) placed in their designated location(s)?
  - Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?
  - Is the access impeding travel to the fire extinguisher blocked or restricted in any way?
  - Has the fire extinguisher been partially or completely discharged?
  - Is there signs of obvious physical damage?
  - Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?

This inspection shall be documented on the attached tag provided by the maintenance/hydrostatic inspection service.

**FIRE EXTINGUISHER CHECKLIST**  
**NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

<b>Project Name:</b> <u>NTC Great Lakes</u>	<b>CTO</b> 0154	<b>Date of Inspection:</b> _____			
<b>Fire Extinguisher Identification</b> <b>Number:</b> _____		<b>Fire Extinguisher Location:</b> _____			
<b>Measurement Criteria</b>	<b>Yes</b>	<b>No</b>	<b>N/A</b>	<b>Needs Repaired</b>	
Are the fire extinguisher(s) placed in their designated location(s)?					
Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?					
Is the access impeding travel to the fire extinguisher blocked or restricted in any way?					
Has the fire extinguisher been partially or completely discharged?					
Is there signs of obvious physical damage?					
Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?					

**FIRE EXTINGUISHER CHECKLIST**  
**NTC GREAT LAKES, GREAT LAKES, ILLINOIS**

<b>Project Name:</b> <u>NTC Great Lakes</u>	<b>CTO</b> 0154	<b>Date of Inspection:</b> _____			
<b>Fire Extinguisher Identification</b> <b>Number:</b> _____		<b>Fire Extinguisher Location:</b> _____			
<b>Measurement Criteria</b>	<b>Yes</b>	<b>No</b>	<b>N/A</b>	<b>Needs Repaired</b>	
Are the fire extinguisher(s) placed in their designated location(s)?					
Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?					
Is the access impeding travel to the fire extinguisher blocked or restricted in any way?					
Has the fire extinguisher been partially or completely discharged?					
Is there signs of obvious physical damage?					
Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?					

## **APPENDIX VIII**

### **HEALTH AND SAFETY PLAN ADDITIONS (HOT SPOT REMOVAL)**

## **APPENDIX IX**

**QUALITY ASSURANCE PROJECT PLAN, SUPPLEMENTAL FIELD SAMPLING  
PLAN, AND HEALTH AND SAFETY PLAN  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**

# **Quality Assurance Project Plan, Supplemental Field Sampling Plan, and Health and Safety Plan**

**Site 22 - Building 105  
Old Dry Cleaning Facility**

**Remedial Investigation &  
Risk Assessment**

**Appendix IX**

**Naval Training Center Great Lakes  
Great Lakes, Illinois**



**Southern Division  
Naval Facilities Engineering Command**

**Contract Number N62467-94-D-0888**

**Contract Task Order 0290**

June 2003

**QUALITY ASSURANCE PROJECT PLAN,  
SUPPLEMENTAL FIELD SAMPLING PLAN,  
AND HEALTH AND SAFETY PLAN  
SITE 22 – BUILDING 105  
OLD DRY CLEANING FACILITY**

**REMEDIAL INVESTIGATION & RISK ASSESSMENT**

**NAVAL TRAINING CENTER GREAT LAKES  
GREAT LAKES, ILLINOIS**

**COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**


**Submitted to:  
Southern Division  
Naval Facilities Engineering Command  
2155 Eagle Drive  
North Charleston, South Carolina 29406**

**Submitted by:  
Tetra Tech NUS, Inc.  
661 Andersen Drive  
Foster Plaza 7  
Pittsburgh, Pennsylvania 15220**

**CONTRACT NUMBER N62467-94-D-0888  
CONTRACT TASK ORDER 0290**

**JUNE 2003**

**PREPARED UNDER THE SUPERVISION OF:**

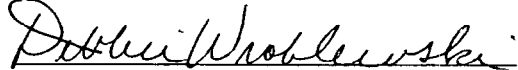
  
**ROBERT F. DAVIS, JR., P.E.  
TASK ORDER MANAGER  
TETRA TECH NUS, INC.**

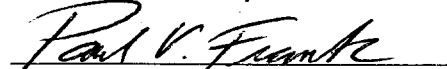
**ANTHONY ROBINSON  
REMEDIAL PROJECT MANAGER  
NAVAL FACILITIES ENGINEERING COMMAND**

**DAN FLEMING  
IR PROGRAM MANAGER  
NAVAL TRAINING CENTER GREAT LAKES**

**MARK SCHULTZ  
ENVIRONMENTAL SITE MANAGER  
NAVAL TRAINING CENTER GREAT LAKES**

**APPROVED FOR SUBMITTAL BY:**

  
**DEBBIE WROBLEWSKI  
PROGRAM MANAGER  
TETRA TECH NUS, INC.**

  
**PAUL V. FRANK  
QUALITY ASSURANCE MANAGER  
TETRA TECH NUS, INC.**

**BRIAN A. CONRATH  
PROJECT MANAGER  
ILLINOIS EPA**

**LESLIE MORROW  
RISK ASSESSOR  
ILLINOIS EPA**

## **PREFACE**

This Quality Assurance Project Plan (QAPP) Appendix IX has been prepared by Tetra Tech NUS (TtNUS), on behalf of the United States (U.S.) Navy Southern Division Naval Facilities Engineering Command and Naval Training Center (NTC) Great Lakes, Great Lakes, Illinois under the Comprehensive Long-term Environmental Action Navy (CLEAN) III Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0290.

The investigation at Site 22 – Building 105 Old Dry Cleaner Facility will be similar to the investigation at Site 7. This QAPP Appendix IX is intended to be used in conjunction with the project-specific Field Sampling Plan (FSP) and Health and Safety Plan (HASP) submitted herewith, as well as the existing QAPP for Site 7 – RTC Silk Screen Shop and Site 17 – Pettibone Creek & Boat Basin, Remedial Investigation & Risk Assessment, the project planning document for NTC Great Lakes (TtNUS, 2001).

This QAPP Appendix IX and the existing QAPP present the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the Site 22 - Building 105 Old Dry Cleaning Facility at NTC Great Lakes. Specific protocols for sampling, sample handling and storage, chain of custody, and laboratory and field analyses are described.

## TABLE OF CONTENTS

<b><u>SECTION</u></b>	<b><u>PAGE NO.</u></b>
<b>PREFACE.....</b>	<b>iii</b>
<b>A. PROJECT MANAGEMENT.....</b>	<b>IX-A-1</b>
A5.A.4 Site 22 - Building 105 Old Dry Cleaning Facility.....	IX-A-1
A5.B Project Problem Statement.....	IX-A-3
A6.A.2 Project Target Parameters.....	IX-A-4
A6.A.3 Project Target Matrices.....	IX-A-4
A6.A.4 Special Project Target Analytes .....	IX-A-4
A6.B Schedule .....	IX-A-5
<b>B. DATA GENERATION AND ACQUISITION .....</b>	<b>IX-B-1</b>
B1.C Site 22 – Building 105 Old Dry Cleaning Facility.....	IX-B-1
B2.A.13 Site 22 – Surface and Subsurface Soil Sampling.....	IX-B-1
B2.A.14 Site 22 – Monitoring Well Installation .....	IX-B-3
B2.A.15 Site 22 – Monitoring Well Construction .....	IX-B-4
B2.A.16 Site 22 – Groundwater Sampling.....	IX-B-4
<b>REFERENCES .....</b>	<b>IX-R-1</b>
<b><u>APPENDICES</u></b>	
IX-I.3 Human Health Risk Assessment Work Plan – Site 22	
IX-V Supplemental Field Sampling Plan and Standard Operating Procedures–Site 22	
IX-VII Health and Safety Plan – Site 22	

## TABLES

<b><u>NUMBER</u></b>	
A-18	Soil Frequency of Detection, Site 22 – Building 105 Old Dry Cleaning Facility
A-19	Groundwater Frequency of Detection, Site 22 – Building 105 Old Dry Cleaning Facility
A-20	Project Target Parameters, Matrices, and Rationales, Site 22 – Building 105 Old Dry Cleaning Facility
B-23	Surface Soil/Subsurface Soil Samples, Site 22 – Building 105 Old Dry Cleaning Facility
B-24	Field Sample Summary – Soil, Site 22 – Building 105 Old Dry Cleaning Facility
B-25	Well Summary, Site 22 – Building 105 Old Dry Cleaning Facility
B-26	Groundwater Samples, Site 22 – Building 105 Old Dry Cleaning Facility
B-27	Field Sample Summary - Groundwater, Site 22 – Building 105 Old Dry Cleaning Facility



## FIGURES

### **NUMBER**

- A-19 Site Map, Site 22 – Building 105 Old Dry Cleaning Facility
- A-20 Previous Sampling Locations, Site 22 – Building 105 Old Dry Cleaning Facility
- A-21 Soil Exceedances, 0 to 1 foot, Site 22 – Building 105 Old Dry Cleaning Facility
- A-22 Soil Exceedances, 3 feet, Site 22 – Building 105 Old Dry Cleaning Facility
- A-23 Soil Exceedances, 4 to 8 feet, Site 22 – Building 105 Old Dry Cleaning Facility
- A-24 Soil Exceedances, 8 to 12 feet, Site 22 – Building 105 Old Dry Cleaning Facility
- A-25 Groundwater Exceedances , Site 22 – Building 105 Old Dry Cleaning Facility
- A-26 Site 22 Project Schedule
- B-4 Proposed Soil Boring Locations, Site 22 – Building 105 Old Dry Cleaning Facility
- B-5 Proposed Monitoring Well Locations, Site 22 – Building 105 Old Dry Cleaning Facility

## **A. PROJECT MANAGEMENT**

This section is an addendum to Section A of the existing Quality Assurance Project Plan (QAPP), Site 7 – RTC Silk Screen Shop and Site 17 Pettibone Creek & Boat Basin for Naval Training Center (NTC) Great Lakes (TtNUS, 2001). The investigation at Site 22 – Building 105 Old Dry Cleaner Facility will be similar to the investigation at Site 7. Changes to the existing QAPP that are specific to the investigation at Site 22 – Building 105 Old Dry Cleaning Facility are provided below.

### **A5.A.4 Site 22 - Building 105 Old Dry Cleaning Facility**

Site 22 - Building 105 Old Dry Cleaner Facility is located at the NTC Great Lakes, Lake County, Illinois. Site 22 is bounded on the south by Porter Street, on the west by a vacant asphalt paved lot, on the north by Bronson Avenue, and on the east by Sampson Street (see Figure A-19). NTC Great Lakes (U.S. EPA # IL7170024577) has operated with Resource Conservation and Recovery Act (RCRA) interim status authorization since November 19, 1980. Building 105 was originally included in a RCRA Part A permit that has been modified over the past 25 years. The RCRA unit is located in the SE quarter of the NW quarter of the SW quarter of Section 4, Township 44 North, Range 12 East. A RCRA Closure Plan specific to Building 105 was submitted to Illinois Environmental Protection Agency (IEPA) on May 16, 2001. IEPA approved the RCRA Closure Plan for Building 105 in a letter dated June 29, 2001.

Building 105 was constructed in 1939 and was utilized as a dry cleaning facility until 1993 or 1994 when it was converted to a vending machine supply and repair station. The building consists of a slab-on-grade building measuring approximately 150 feet by 70 feet. The 10,500-square foot building occupied a lot approximately 250 feet by 115 feet. From 1993 or 1994 until February 2001, the building was used to warehouse and repair vending equipment and products. The vending machine supply and repair operations ceased in February 2001, and the building was vacant until it was demolished in March 2003.

The RCRA unit (SO1) in Building 105 consisted of a drum storage area located inside along the east wall. Hazardous waste consisting of spent tetrachloroethene (PCE) from the laundry facilities was stored in this area from 1980 until 1987. The maximum quantity of waste stored at this unit is unknown; however according to the revised RCRA permit, 165 gallons (three 55-gallon drums) was the maximum amount of waste stored at one time in this area. The storage area consisted of the concrete floor (no berms or curbs were present) of the building adjoining the concrete block exterior wall. Near the storage area, two cracks and construction joints in the concrete floor, a garage-type entry door, and several floor drains were observed. Historic building foundation plans show the floor drains were connected to the storm

water system located outside of the building. No visual evidence of spillage (no staining) was observed or reported in this area, and the floor was in good condition.

The building foundation plans also show two 6-inch drains from the gutter under the washing machines associated with previous laundry operations. These drains were connected to a grease catch basin located outside the southeastern corner of the building by a 6-inch cast iron pipe. The grease catch basin was approximately 5 feet by 7.5 feet by 5.5 feet deep with two chambers and had a 6-inch tile effluent pipe that was connected to another catch basin.

Previous investigations at Building 105 resulted in correspondence with the IEPA, the implementing agency for unit closure. Soil and groundwater sampling (locations shown on Figure A-20) was conducted at Building 105 as documented in the Partial Closure Certification and Sampling/Inspection Report (PCC&SIR) (Earth Tech, 1998). According to the PCC&SIR, the chemicals of concern (COCs) are PCE and cis-1,2-dichloroethene (DCE) in soil and PCE and DCE in groundwater.

#### Previously Documented Soil Contamination

Shallow soil samples were collected from 0 to 12 inches below grade in 1993. Twenty-four additional soil samples were collected between 1995 and 1998, to a maximum depth of 6 feet. At sample point GL95-105S-134, the vertical extent of the soil plume was determined to be 72 inches deep or the top of the saturated zone. Contaminated soil samples in the saturated zone, greater than approximately 72 inches below ground surface (bgs), are considered by IEPA to be a groundwater issue. In 2001, additional core samples were examined for ionizable vapor concentrations utilizing a photoionization detector (PID), and samples were collected for analysis at both the former hot spots and other locations where PID readings exceeded background in the vadose zone. Most of these soil samples were collected from 8 to 12 feet bgs. Maximum contaminant levels detected for soil samples from these investigations were as follows:

- PCE at 1,500,000 µg/kg at GL95-105S-1: 30 to 36 inches deep
- DCE at 820 µg/kg at GL98-105S-1 and TOL01-GP04: 9.5 to 10 inches deep
- Acetone at 43,000 µg/kg at GL95-105s-12: 0 to 6 inches deep
- Trichloroethene (TCE) at 7 µg/kg at GL93-105S-2: assumed collected at the surface

Table A-18 provides a summary of the results of previous soil sampling and Figures A-21 to A-24 show exceedances of IEPA Tiered Approach to Corrective Action Objectives (TACO) soil criteria at depths of 0 to 1 foot, 3 feet, 4 to 8 feet, and 8 to 12 feet, respectively. Concentrations of PCE and cis-1,2-DCE in soil

exceeded IEPA TACO Class I soil to groundwater clean up objectives. The concentrations of PCE in soil also exceeded the IEPA TACO soil ingestion and inhalation exposure route clean up objectives. The acetone detection was considered a lab contamination issue; therefore, acetone was not included on the list of COC. TCE was detected in two locations, but not considered a COC for the following reasons:

- the one location had a TCE concentration of 7 µg/kg in the surface soils (0 to 6 inches bgs); therefore, this contamination would be removed as part of the demolition activities and not considered a pertinent laboratory parameter for the RCRA closure.
- the second location had a TCE concentration of 6 µg/kg in the surface soil (5 to 6 inches bgs). The laboratory report qualifies this TCE result with a "J", which signifies that the result is an estimate. In addition, the detected concentration is within 1 µg/kg of the clean up objective for TCE (5 µg/kg). Based on the shallow occurrence of these detections and the estimated low concentration, TCE was not included as a COC in soil for purposes of RCRA closure at Building 105.

#### Previously Documented Groundwater Contamination

Previous reports indicate that groundwater samples were collected from the shallow groundwater zone, approximately 5 feet below the water table (11 to 15 feet bgs) between 1996 and 2001. The vertical extent of the dense non-aqueous phase liquid (DNAPL) groundwater plume was not determined by previous investigations. Maximum contaminant levels detected for groundwater samples were as follows:

- PCE at 7,400 µg/L at GL96-105G-03
- DCE at 3,200 µg/L at TOL01-GP01

The "hot spot" is apparently located on the southern and eastern sides of the building along Sampson Street. Table A-19 provides a summary of the results of previous groundwater sampling and Figure A-25 show exceedances of IEPA TACO groundwater criteria.

#### **A5.B Project Problem Statement**

Because of operationally related chemical releases detected at Site 22 during the previous investigations, risks to human and ecological receptors could be unacceptable. The risks are expected to be confined primarily to vapors/air, aqueous, and solid media.

Past sampling, although limited in some areas, identified the presence of select contaminants at Site 22. Previous sampling has not been adequate to delineate the extent of contamination. This investigation is designed to further delineate the nature and extent of contamination in groundwater and soil believed to be related to a Navy source. It is also designed to provide information to implement a baseline human health risk assessment (see Appendix I.3), a screening-level ecological risk assessment, and Step 3A of the baseline ecological risk assessment process (see Appendix II.1). Because of these general objectives, several decision statements have been developed for this project that apply to multiple environmental media. The decision statements that will facilitate attainment of the project objectives for Site 22 are shown on Figures A-6 to A-11.

### **Project Status/Phase**

One round of sampling is expected for this investigation. The need for additional sampling rounds will be determined based on whether the extent of contamination is established within prescribed bounds of the data quality objectives. The strategy for additional sampling rounds will be similar to this initial phase of sampling when establishing extent of contamination.

#### **A6.A.2 Project Target Parameters**

A detailed list of target analytes and associated environmental media at Site 22 is presented in Table A-20.

#### **A6.A.3 Project Target Matrices**

For Site 22, the matrices to be sampled are groundwater, surface soil, and subsurface soil.

#### **A6.A.4 Special Project Target Analytes**

A detailed list of target analytes and associated environmental matrices specific to Site 22 is presented in Table A-20. No special analytical methods will be used in support of this investigation. In general, the methods selected are standard U.S. EPA methods. The selected methods are suitable for measuring the target analytes in the matrices of interest at the concentration levels of interest.

Some analytical measurements will be made in the field. The field measurements are designed for four basic purposes:

1. To support health and safety functions

2. To provide screening-level information to confirm that groundwater sampling conditions are stable before groundwater samples are collected
3. To direct VOC sampling from soil matrices
4. To provide data for analysis of monitored natural attenuation as a possible remedial action for the groundwater.

None of the field analytical results will be used directly in establishing the nature and extent of contamination or in evaluating risks. Field and laboratory analytical tasks are differentiated and delineated in Section B of this QAPP.

#### **A6.B Schedule**

The schedule for preparation of the QAPP, implementation of the field work and laboratory analysis, evaluation of the data, and preparation of the remedial investigation/risk assessment (RI/RA) report is shown on Figure A-26. The schedule includes approximately 30 days for regulatory review of the draft QAPP and RI/RA report, as well as time for several meetings to discuss the project. Project delays will be communicated by the TtNUS TOM to the Navy RPM, IEPA PM, and U.S. EPA PM.

**TABLE A-18**  
**SOIL FREQUENCY OF DETECTION**  
**SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Range of Detections	Average of Detections	Location of Maximum Detection	IEPA TACO Exposure Route-Soil to Groundwater <sup>1</sup>	IEPA TACO Exposure Route-Soil Inhalation <sup>1</sup>	IEPA TACO Exposure Route-Soil Ingestion <sup>1</sup>
<b>VOLATILE ORGANICS (ug/kg)</b>							
1,1-Dichloroethene	1/1	6	6	TOL01-GP01B	60	1500000	700000
cis-1,2-Dichloroethene	5/5	21 - 820	491	GL98-105S-11, TOL01-GP04	400	1200000	780000
Tetrachloroethene	38/38	10 - 1500000	89064	GL95-105S-13	60	11000	12000
trans-1,2-Dichloroethene	1/1	16	16	TOL01-GP01B	700	3100000	1600000
<b>MISCELLANEOUS PARAMETERS (mg/kg)</b>							
Percent Moisture	10/10	13.1 - 25.8	19	TOL01-GP01A	NA	NA	NA
Percent Solids	10/10	74.2 - 86.9	81	TOL01-GP13	NA	NA	NA
Specific Gravity	1/1	2.0201	2	TOL01-GP11	NA	NA	NA
Total Organic Carbon	2/2	13000 - 55000	34000	TOL01-GP01A	NA	NA	NA

NA - Not applicable

<sup>1</sup>Tiered Approach to Corrective Action Objectives (TACO) (IEPA, 1996 revised 2003)

Note: Shaded IEPA TACO criteria are screening values that are less than the maximum detected concentration

Associated Samples:

GL95-105S-101	GL95-105S-21	GL95-105S-71
GL95-105S-103	GL95-105S-23	GL95-105S-81
GL95-105S-11	GL95-105S-31	GL95-105S-83
GL95-105S-113	GL95-105S-33	GL95-105S-91
GL95-105S-121	GL95-105S-41	GL95-105S-93
GL95-105S-123	GL95-105S-43	GL98-105S-11
GL95-105S-124	GL95-105S-51	GL98-105S-12
GL95-105S-13	GL95-105S-53	GL98-105S-13
GL95-105S-131	GL95-105S-61	GL98-105S-14
GL95-105S-133	GL95-105S-63	GL98-105S-15
GL95-105S-134	GL95-105S-64	TOL01-GP01A

**TABLE A-19**  
**GROUNDWATER FREQUENCY OF DETECTION**  
**SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Frequency of Detection	Range of Detections	Average of Detections	Location of Maximum Detection	IEPA TACO Exposure Route-Groundwater Ingestion <sup>1</sup>
<b>VOLATILE ORGANICS (ug/L)</b>					
1,1-Dichloroethene	1/1	0.6	0.6	TOL01-GP05WG	7
cis-1,2-Dichloroethene	6/6	0.7 - 3200	777	TOL01-GP01WG	70
Tetrachloroethene	9/9	2 - 7400	1617	GL96-105G-03	5
trans-1,2-Dichloroethene	3/3	1 - 35	16	TOL01-GP01WG	100

<sup>1</sup>Tiered Approach to Corrective Action Objectives (TACO) (IEPA, 1996 revised 2003)

Note: Shaded IEPA TACO criteria are screening values that are less than the maximum detected concentration

Associated Samples:

GL98-105G-13WG

TOL01-GP01WG

TOL01-GP02WG

TOL01-GP05WG

TOL01-GP07WG

TOL01-GP08WG

TOL01-GP13WG

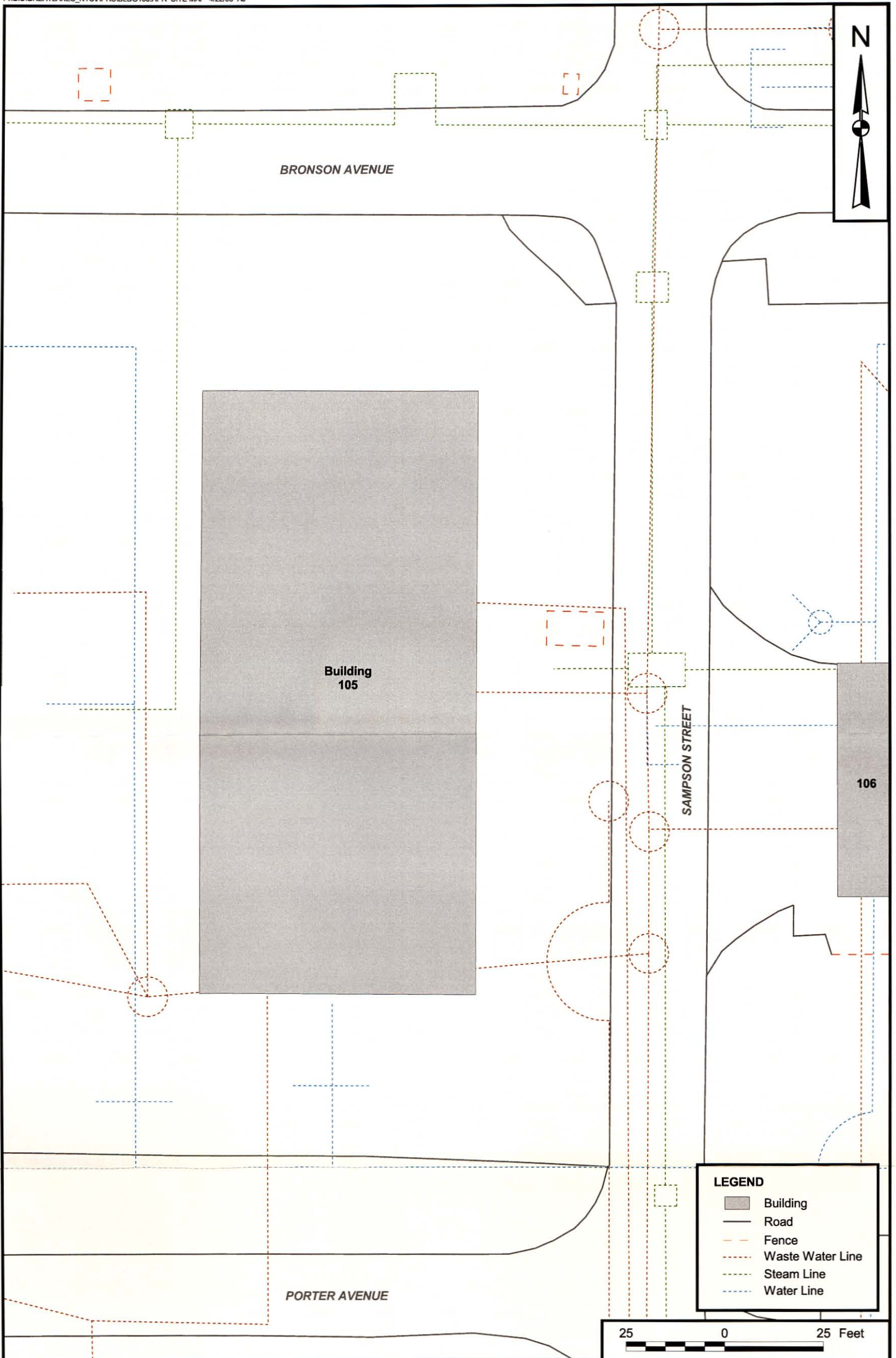


TABLE A-20

**PROJECT TARGET PARAMETERS, MATRICES, AND RATIONALES**  
**SITE 22 – BUILDING 105 OLD DRY CLEANER FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

Parameter	Environmental Medium			Intended Data Use
	GW	SS	SB	
Target Compound List (TCL) chlorinated volatile organics (1,1,1-Trichloroethane [TCA], 1,1,1,2-TCA, 1,1,2,2-TCA, 1,1,2-TCA, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,1-DCE, carbon tetrachloride, chloroethane, chloromethane, cis-1,2-DCE, trans-1,2-DCE, PCE, TCE, vinyl chloride)	X	X	X	Delineating the nature and extent of contamination
Methane, ethane, ethane, iron, manganese, alkalinity, sulfate, sulfide, nitrate, nitrite, chloride	X	-	-	Natural attenuation analysis
Dissolved oxygen, carbon dioxide, Manganese, ferrous iron, alkalinity, sulfide, hydrogen sulfide – test kits <sup>(f)</sup>	X	-	-	Natural attenuation analysis
Total organic carbon (TOC)	X	X	X	Organic chemical bioavailability
Toxicity Characteristic Leaching Procedure (TCLP) organics and inorganics	X	X	X	Waste disposal characterization
Grain Size/porosity	-	X	X	Soil physical characterization
pH <sup>(f)</sup>	X	-	-	Aquifer stabilization prior to sampling and natural attenuation analysis
Turbidity <sup>(f)</sup>	X	-	-	Aquifer stabilization prior to sampling
Specific conductance <sup>(f)</sup>	X	-	-	Aquifer stabilization prior to sampling
Dissolved oxygen - meter <sup>(f)</sup>	X	-	-	Aquifer stabilization prior to sampling
Hydraulic conductivity <sup>(f)</sup>	X	-	-	Aquifer characteristics
Temperature <sup>(f)</sup>	X	-	-	Aquifer stabilization prior to sampling and natural attenuation analysis
Oxidation-reduction potential (ORP) <sup>(f)</sup>	X	-	-	Aquifer stabilization prior to sampling and natural attenuation analysis

f Field analysis  
GW – ground water  
SS – surface soil  
SB – subsurface soil



**LEGEND**

- Building
- Road
- Fence
- Waste Water Line
- Steam Line
- Water Line

DRAWN BY	DATE
J. LAMEY	4/10/03
CHECKED BY	DATE
F. WUDKWYCH	4/22/03
COST/SCHEDULE-AREA	
SCALE AS NOTED	

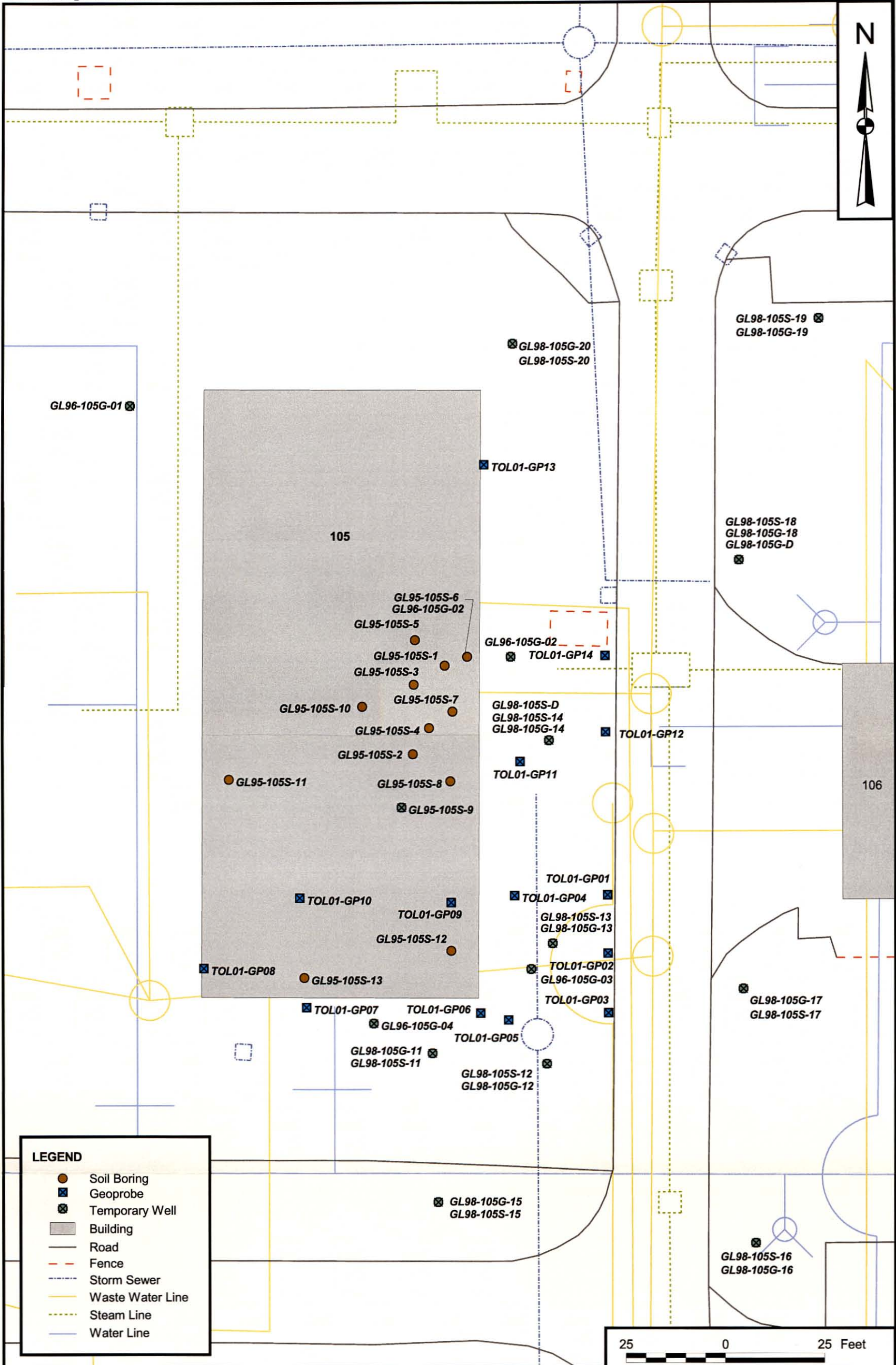



SITE MAP  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NAVAL TRAINING CENTER  
GREAT LAKES, ILLINOIS

CONTRACT NUMBER N1474	
APPROVED BY RFD	DATE 4/22/03
APPROVED BY	DATE
DRAWING NO. FIGURE A - 19	REV 0

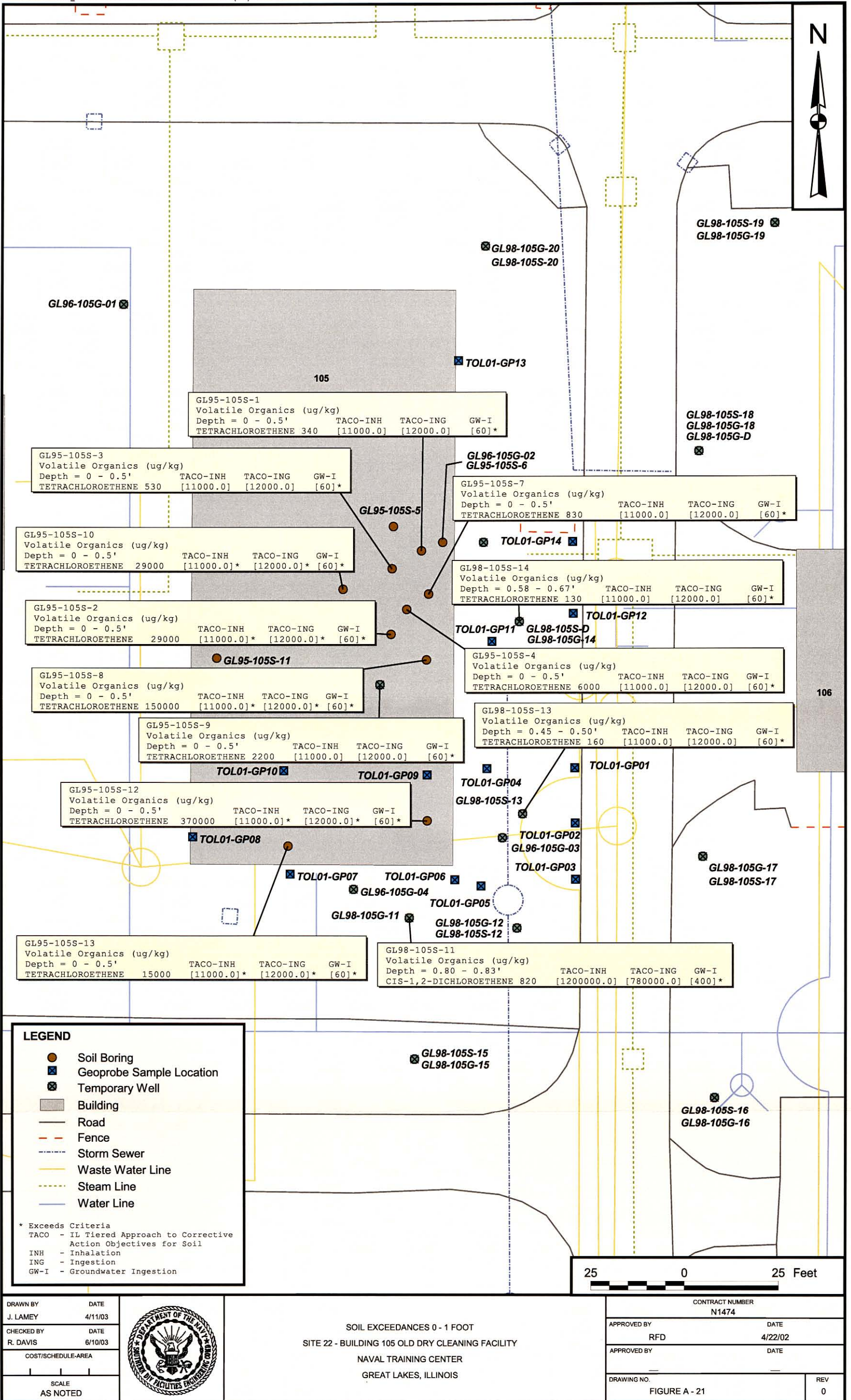
000149DB047



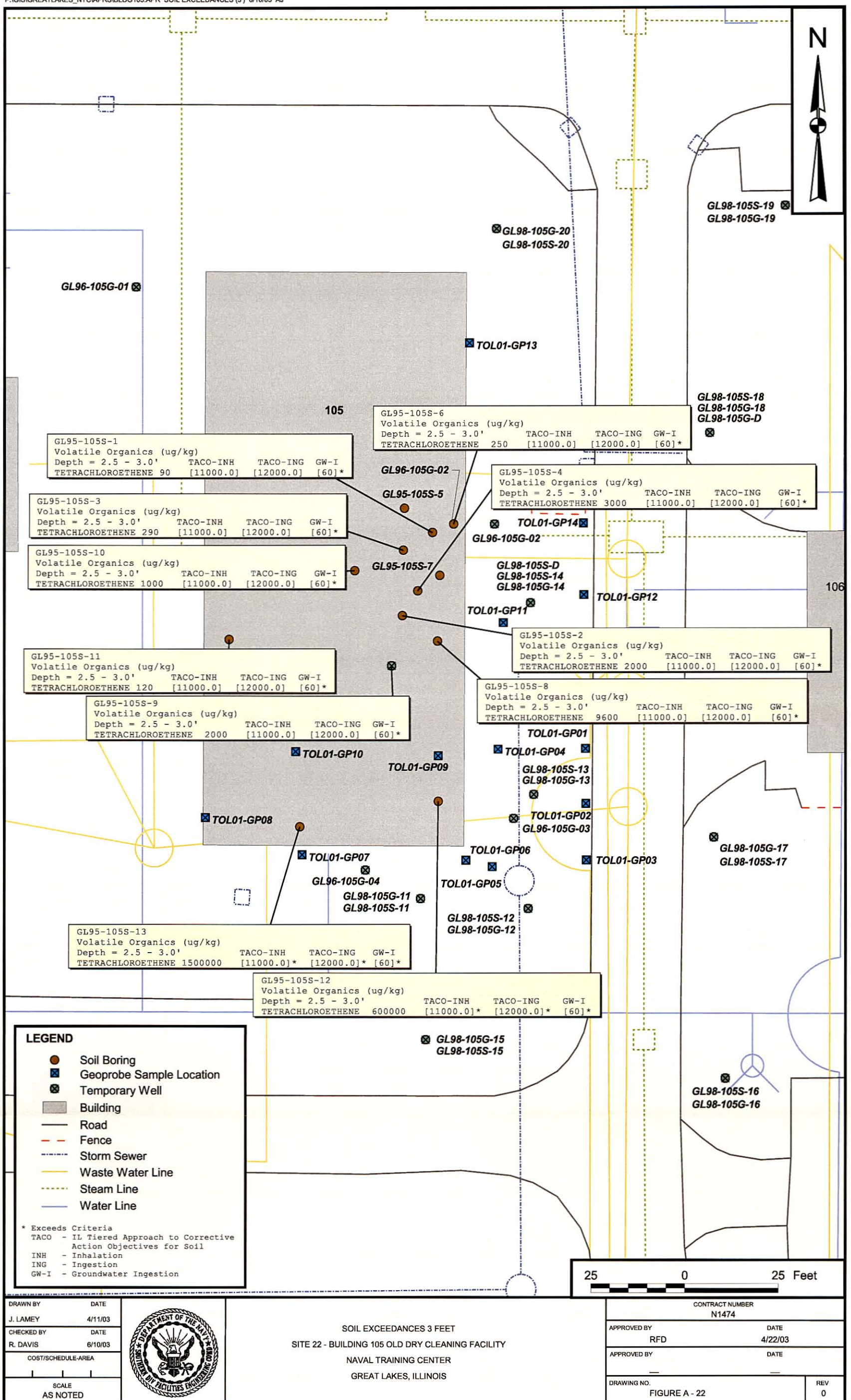


<b>LEGEND</b> ● Soil Boring ■ Geoprobe ⊗ Temporary Well ■ Building — Road - - - Fence - - - Storm Sewer — Waste Water Line - - - Steam Line — Water Line			PREVIOUS SAMPLING LOCATIONS SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NUMBER N1474	
DRAWN BY J. LAMEY	DATE 4/10/03			APPROVED BY RFD	DATE 4/22/03
CHECKED BY F. WUDKWYCH	DATE 4/22/03			APPROVED BY	DATE
COST/SCHEDULE-AREA				DRAWING NO. FIGURE A - 20	REV 0
SCALE AS NOTED					

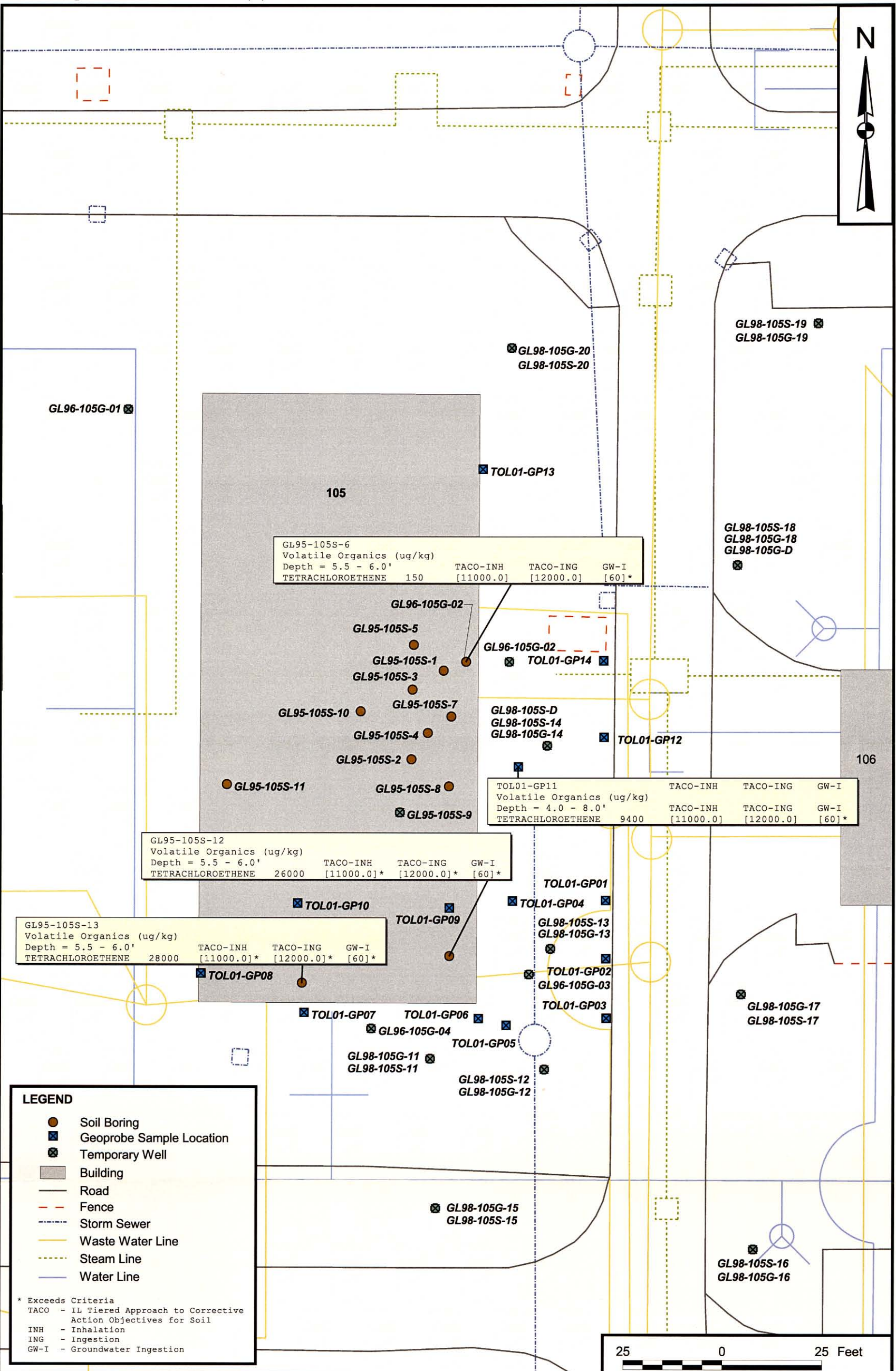













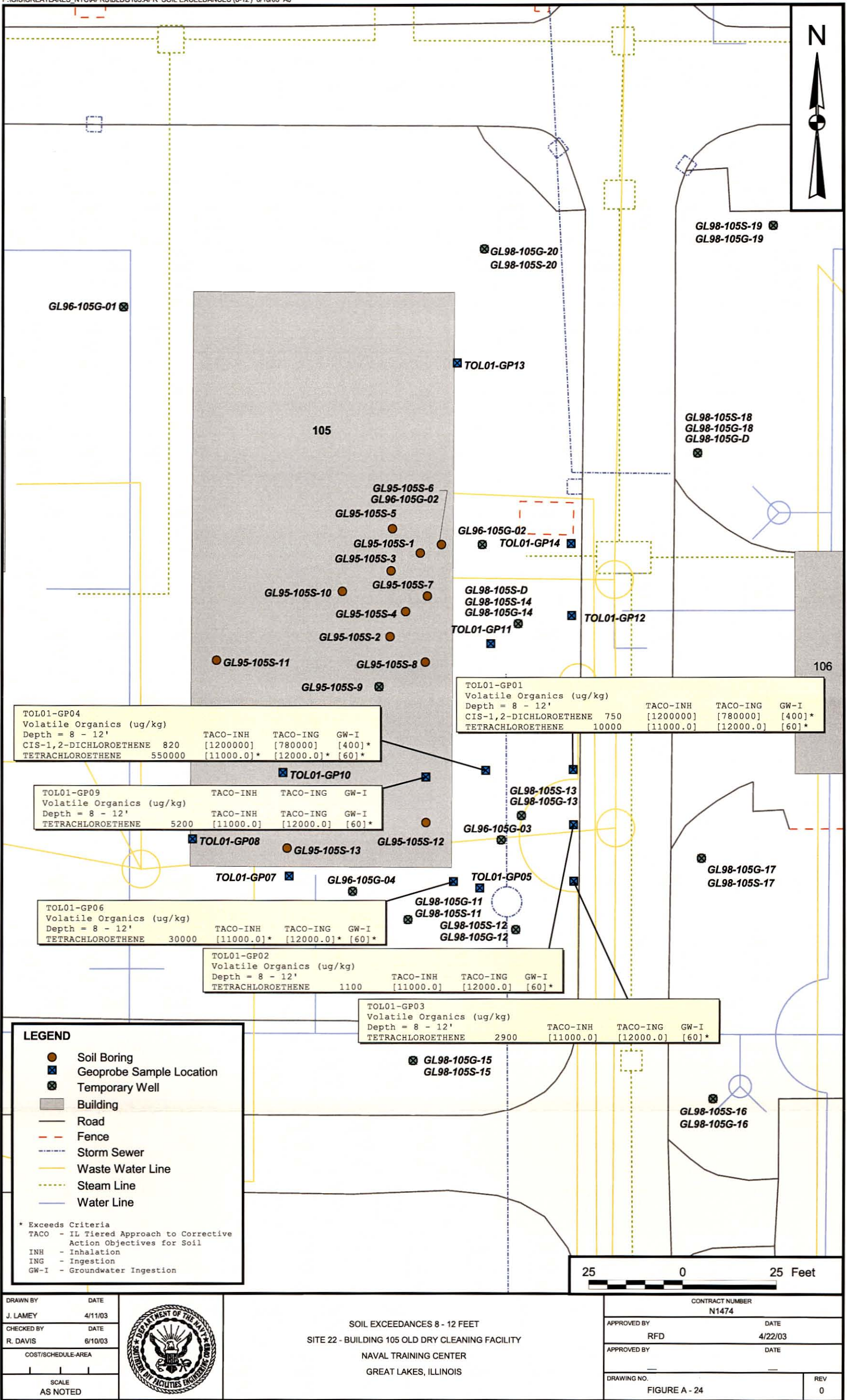
DRAWN BY J. LAMEY		DATE 4/11/03	
CHECKED BY R. DAVIS		DATE 6/10/03	
COST/SCHEDULE-AREA			
SCALE AS NOTED			



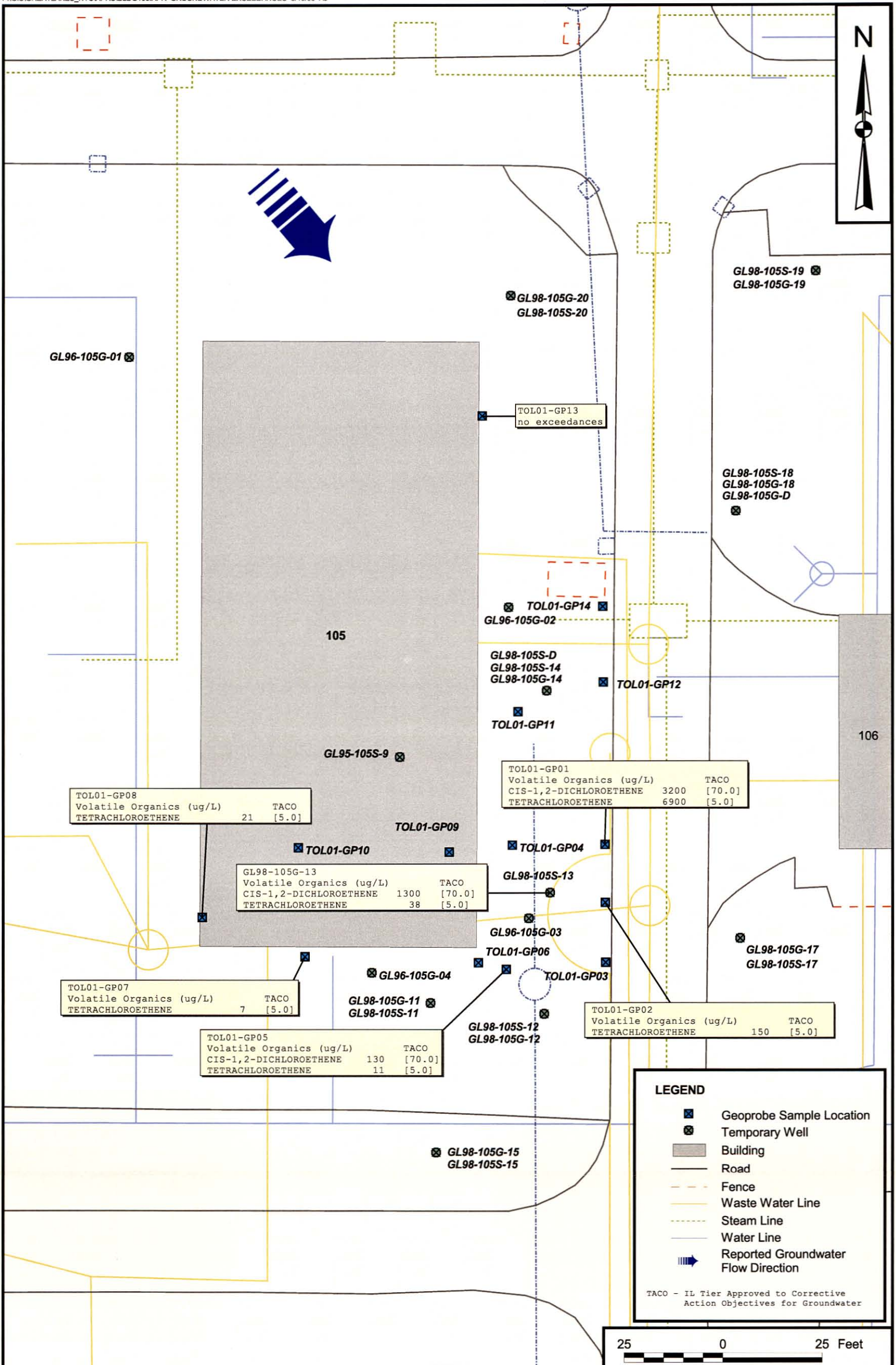
SOIL EXCEEDANCES 4 - 8 FEET  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NAVAL TRAINING CENTER  
GREAT LAKES, ILLINOIS


CONTRACT NUMBER N1474	
APPROVED BY RFD	DATE 4/22/03
APPROVED BY	DATE
DRAWING NO. FIGURE A - 23	REV 0







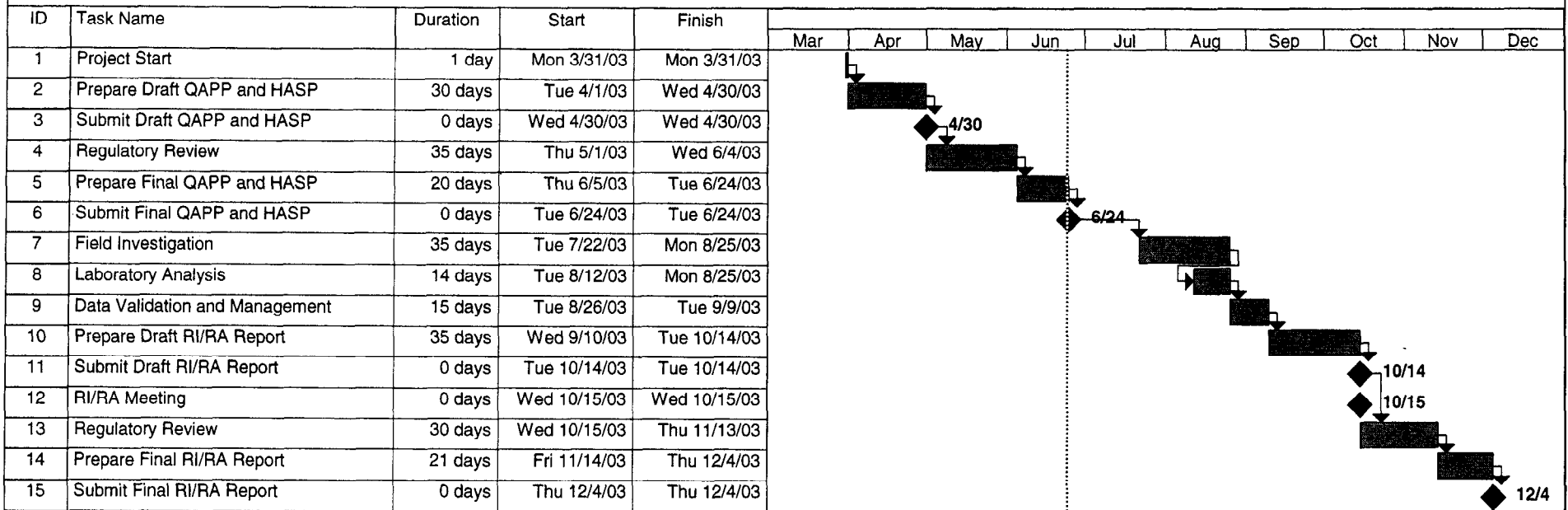


DRAWN BY J. LAMEY	DATE 4/10/03		GROUNDWATER EXCEEDANCES SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS	CONTRACT NUMBER N1474	
CHECKED BY R. DAVIS	DATE 6/10/03			APPROVED BY RFD	DATE 4/22/03
COST/SCHEDULE-AREA				APPROVED BY	DATE
SCALE AS NOTED				DRAWING NO. FIGURE A - 25	REV 0



**FIGURE A-26  
PROJECT SCHEDULE  
SITE 22 - BUILDING 105 OLD DRY CLEANER FACILITY  
NTC GREAT LAKES, ILLINOIS**

NTC Great Lakes  
QAPP Site 22  
Revision : 0  
Date: June 2003



Task		Rolled Up Task		Project Summary	
Split		Rolled Up Split		External Milestone	
Progress		Rolled Up Milestone		Deadline	
Milestone		Rolled Up Progress			
Summary		External Tasks			

## **B. DATA GENERATION AND ACQUISITION**

This section is an addendum to Section B of the existing QAPP (TtNUS, 2001) for NTC Great Lakes. The planned investigation at Site 22 – Building 105 Old Dry Cleaner Facility will be similar to the investigation at Site 7. Changes to the existing QAPP are noted in the text below.

### **B1.C      Site 22 - Building 105 Old Dry Cleaning Facility**

Site 22 historical sampling indicated that a contaminant release has occurred, and it is likely that the conditions may have changed since the last sampling event. Site conditions related to contaminant release and migration pathways indicate a potential for migration of site contaminants. Groundwater was impacted by the release. A judgmental sampling design was used to maximize the potential for determining the extent of contamination while providing enough data to estimate risks. The risk estimates, because they are generally biased toward contaminated areas, are expected to be elevated relative to the actual human risk at the site. Details of the human health risk scenarios are presented in Appendix I.3 (attached to this appendix).

Soil and groundwater sampling locations are presented in Figures B-4 and B-5, respectively. Soil sampling locations and depths are consistent with the human receptor exposure scenarios and were selected to estimate contaminant concentrations for establishing the nature and extent of contamination and to estimate human health risk for receptors exposed to surface and subsurface soils. The well locations were selected to provide water level data useful for estimating groundwater flow direction, and to provide data on the nature and extent of contamination and risk to human receptors.

### **B2.A.13      Site 22 - Surface and Subsurface Soil Sampling**

This section of the QAPP addendum describes the sampling procedures for the field investigation at Site 22 – Old Dry Cleaning Facility. Additional information is provided in Section B2.A.1 of the existing QAPP. Ten surface and 30 subsurface soil samples will be collected from 9 monitoring well locations and 9 soil boring locations from locations chosen based on visual observation and historical data from Site 22. Two subsurface soil samples will be collected from most of the soil and monitoring well borings.

Surface and subsurface soil samples will be collected using Direct Push Technology (DPT), Hollow Stem Auger (HSA) and split-spoon sampling techniques, a stainless steel hand auger, or single-use, dedicated plastic trowels. Upon sample retrieval, the samples will be monitored with a PID to detect VOCs and then retained for lithologic and chemical analysis. Samples for chlorinated VOC analysis will be collected with

EnCore samplers. Samples for other analysis (i.e. total organic carbon, grain size, etc.) will be collected using a disposable plastic trowel. The samples will immediately be placed in a cooler at 4°Celsius. Before samples are obtained, pertinent ambient conditions and field data will be recorded in the field logbook and on the soil sample log sheet (included in Appendix V). For additional guidance regarding surface soil sampling, refer to Appendix V, SOP CTO 154-6. Tables B-23 and B-24 present summaries of soil samples to be collected at Building 105, including numbers and types of QA/QC samples.

If the soil recovery from the first sample collection attempt produces an inadequate yield to fill sample containers an alternative method will be used to fill the remaining sample containers. The alternative method could be to offset the sample location a foot and resample the interval.

Soil borings will be installed by DPT or HSA methods at Building 105, including:

- The borings will be located at locations shown on Figures B-4 and B-5. Their depths will be to 20 feet bgs with one soil boring to 50 feet bgs for lithologic purposes. Boring 22SB01/22MW01, the most upgradient location will be drilled first to a depth of 50 feet to identify confining layers that would intercept possible dense, non-aqueous phase liquids. This soil boring will provide the detailed lithological description of the soil column/site. This will be used to build the Conceptual Site Model. If additional information for the lithology is required, boring 22SB02/22MW02S and 22SB04/22MW04S may be drilled to a deeper depth. The depth of Boring 22SB01/22MW01 or the use of the other locations will be based on field observations and field decisions to be made after consultation with the TtNUS TOM, Navy, and Illinois EPA to allow for flexibility in the investigation.
- Soil borings will be converted to monitoring wells after soil samples are collected from the boring. These monitoring wells will be used to determine groundwater quality and flow direction.
- Soil samples will be collected from each soil boring according to the depths described in Table B-23 and as follows:
  - Surface soil samples will be collected immediately below the high density polyethylene (HDPE) liner and gravel located approximately 1 foot bgs.
  - Between 1 foot bgs and the water table, a sample for chlorinated VOC analysis will be collected from the 1 foot interval with the highest PID reading. If no elevated PID readings are observed, the subsurface sample will be collected based on visual observations of staining or non-native

soil. If neither of these situations is encountered, the sample will be collected immediately above the water table or from a randomly selected 1 foot interval (see SOP CTO 154-6).

- Several borings will also collect a "clean" sample to delineate the vertical limit of contamination.

Surface and subsurface soil samples will be collected from soil borings using DPT 4 foot core samplers or HAS and 2 foot split-spoon samplers, as appropriate. The surface and subsurface soil sampling will be conducted in accordance with SOP CTO 154-6, contained in Appendix V.

Upon sample retrieval, the soil to be analyzed for chlorinated VOCs will be collected first using EnCore samplers and placed in a cooler of ice maintained at 4°C. The soil to be analyzed for other parameters (i.e., TOC, grain size, etc.) will then be mixed, placed into the required containers, immediately sealed, and placed in a cooler at 4°C. The 4 foot-long clear plastic sleeves inside of the DPT samplers will be cleaned of visual soil and will be decontaminated in accordance with Section B2.B Cleaning and Decontamination of Equipment/Sample Containers and SOP CTO154-8. One rinsate sample will be collected and analyzed and based on the results of the analysis the sleeves will be disposed (anticipated to be disposed of as trash). The disposal activity will be documented and will occur at the same time as the disposal of the IDW drums.

Analytical parameters for surface and subsurface soil samples include the following:

- TCL chlorinated VOCs (1,1,1-Trichloroethane [TCA], 1,1,1,2-TCA, 1,1,2,2-TCA, 1,1,2-TCA, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,1-DCE, carbon tetrachloride, chloroethane, chloromethane, cis-1,2-DCE, trans-1,2-DCE, PCE, TCE, vinyl chloride)
- Total organic carbon (TOC)
- Grain size (field observations and laboratory analysis) and porosity

#### **B2.A.14 Site 22 - Monitoring Well Installation**

Refer to Section B2.A.3 of the existing QAPP. The monitoring wells to be installed at Site 22 will be installed as permanent wells.

#### **B2.A.15 Site 22 - Monitoring Well Construction**

Refer to Section B2.A.4 of the existing QAPP. The monitoring wells to be installed at Site 22 will be installed as permanent wells. The monitoring wells are planned to be installed at the site in accordance

with Table B-25. The positioning of the well screens will be adjusted in the field based on the soil boring sample locations, PID readings, and the field hydrophobic dye testing results (Spectrum Oil Red O) that identify possible dense, non-aqueous phase liquids. Monitoring well 22MW06D is a deeper well that is located next to the shallow well 22MW06S (nested well pair) in the area of highest contamination based on the historical data. This monitoring well will be used to determine if the lower water column (approximate depth of 40 to 50 feet bgs but the screened interval will be adjusted in the field based on field observations) is contaminated. Downgradient of this nested well pair will be monitoring well 22MW07D, a deeper well that is located next to the shallow well 22MW07S (another nested well pair), to determine if groundwater contamination has migrated in the direction of groundwater flow. Monitoring well 22MW07D is also approximately 40 to 50 feet bgs (screened interval will be adjusted in the field based on field observations). The location of monitoring well 22MW07D will be determined based on the field observations during the drilling program. This well could be nested next to 22MW05S or 22MW09S. The location and sampling of the soil and groundwater for this site will be flexible to allow for field decisions to be made after consultation with the TtNUS TOM, Navy, and Illinois EPA.

#### **B2.A.16 Site 22 - Groundwater Sampling**

Eleven groundwater samples will be collected from the eleven monitoring wells at locations within, upgradient, downgradient, and cross-gradient of the site. The upgradient well to be installed at the northwestern boundary, will be designated 22MW01S. The cross-gradient well located at the northeastern boundary will be designated 22MW02S, and the five wells in and around the source area will be designated 22MW03S, 22MW04S, 22MW05S, and 22MW06S and 22MW06D. The four downgradient/cross-gradient monitoring wells will be designated 22MW07S, 22MW07D, 22MW08S, and 22MW09S. The groundwater sampling will be conducted in accordance with the requirements of the project-specific Work Plan and in accordance with SOP CTO 154-3, contained in Appendix V.

Tables B-25, B-26, and B-27 present summaries of the monitoring wells and the groundwater samples to be collected at Site 22, including numbers of QA/QC samples. Fixed-based laboratory analytical parameters for groundwater samples at Site 22 include the following:

- TCL chlorinated VOCs
- Natural attenuation parameters (methane, ethane, ethane, iron, manganese, alkalinity, sulfate, sulfide, nitrate, nitrite, and chloride for 6 of the 11 groundwater samples).

Field parameters to be measured for groundwater samples at Site 22 include:

- pH
- Turbidity
- Specific conductance
- Dissolved oxygen - meter
- Hydraulic conductivity
- Temperature
- Oxidation-reduction potential (ORP)
- Natural attenuation parameters (manganese, ferrous iron, alkalinity, sulfide, hydrogen sulfide, dissolved oxygen, and carbon dioxide by field test kits) for 6 of the 11 groundwater samples.

This page intentionally left blank.

**TABLE B-23**

**SURFACE SOIL/SUBSURFACE SOIL SAMPLES  
SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY  
NTC GREAT LAKES, ILLINOIS**

Sample/ Boring No.	Sample Depth <sup>(1)</sup>	General Location	Analyses		
			TCL Chlorinated VOCs	TOC <sup>(2)</sup>	Grain Size /Porosity <sup>(2)</sup>
SUBSURFACE SOIL					
22SB01	At Depth <sup>(1)</sup> Bottom of Boring	Northwest of the Building 105	X	TBD	TBD
22SB02	At Depth <sup>(1)</sup>	East of Building 105	X	TBD	TBD
22SB03	At Depth <sup>(1)</sup>	Inside Building 105, along cracks in floor	X	TBD	TBD
22SB04	At Depth <sup>(1)</sup> Clean Bottom of Boring	Southwest edge of Building 105	X	TBD	TBD
22SB05	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	Inside the southern end of Building 105	X	TBD	TBD
22SB06	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	Former grease catch basin area	X	TBD	TBD
22SB07	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	East of former grease catch basin area	X	TBD	TBD
22SB08	0-1 At Depth <sup>(1)</sup>	Outside, southwest corner of Building 105	X	TBD	TBD
22SB09	At Depth <sup>(1)</sup>	South of Building 105	X	TBD	TBD
22SB10	At Depth <sup>(1)</sup>	Eastern edge of Building 105	X	TBD	TBD
22SB11	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	Eastern edge of Building 105	X	TBD	TBD
22SB12	0-1 At Depth <sup>(1)</sup>	Inside center of Building 105	X	TBD	TBD
22SB13	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	Eastern edge of Building 105	X	TBD	TBD
22SB14	0-1 At Depth <sup>(1)</sup>	Inside southwestern corner of Building 105 near drain area	X	TBD	TBD
22SB15	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	Upgradient of former grease catch basin area	X	TBD	TBD
22SB16	At Depth <sup>(1)</sup> Clean Bottom of Boring	South of Building 105	X	TBD	TBD
22SB17	0-1 At Depth <sup>(1)</sup> Clean Bottom of Boring	Southeast corner of Building 105	X	TBD	TBD



**TABLE B-23**

**SURFACE SOIL/SUBSURFACE SOIL SAMPLES  
 SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY  
 NTC GREAT LAKES, ILLINOIS**

Sample/ Boring No.	Sample Depth <sup>(1)</sup>	General Location	Analyses		
			TCL Chlorinated VOCs	TOC <sup>(2)</sup>	Grain Size /Porosity <sup>(2)</sup>
22SB18	At Depth <sup>(1)</sup> Clean Bottom of Boring	Southeast of Building 105	X	TBD	TBD

1 Chlorinated VOC samples to be collected from 0 to 1 foot in the soil below the liner or 0 to 1 foot bgs and at a discrete 1-foot interval from 1 foot to top of groundwater based on the following: elevated PID readings; visual observations of contamination/non-native soils; immediately above the water table or from a randomly selected 1 foot interval. Ten surface soil samples will be collected and the remaining 30 samples will be subsurface soil samples. Several borings will collect a "clean" soil sample to delineate the vertical limit of contamination.

2 To be collected from 6 arbitrary soil samples.

TBD = To be determined  
 TOC = Total organic carbon  
 TCL = Target Compound List

PID = Photoionization detector  
 VOCs = Volatile organic compounds

**TABLE B-24**  
**FIELD SAMPLE SUMMARY - SOIL**  
**SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total <sup>(1)</sup>
<b>Surface/Subsurface Soil</b>								
TCL Chlorinated VOCs	SW-846 Methods 5035/8260B	40	4	1*	TBD	TBD	2	46
TCLP Organics (IDW samples only)	SW-846 Method 1311/8260B/8270C/8081A/8151A	3	NA	NA	TBD	NA	NA	3
TCLP Inorganics (IDW samples only)	SW-846 1311/6010B/7000A series	3	NA	NA	NA	NA	NA	3
Total Organic Carbon	Walkley Black	6	NA	NA	NA	NA	NA	6
Grain Size/Porosity	ASTM D422	6	NA	NA	NA	NA	NA	6

1 Does not include the number of trip or ambient blanks.

\* The rinsate blank is for the plastic sleeves after they have been cleaned and decontaminated.

TCL = Target Compound List

VOCs = Volatile organic compounds

TCLP = Toxicity Characteristic Leaching Procedure

TBD = To be determined. Number of samples will be determined on site depending on conditions encountered during sampling.

NA = Not applicable

NTC Great Lakes  
QAPP Site 22  
Section: Appendix IX - B  
Revision: 0  
Date: June 2003  
Page: 9 of 15

**TABLE B-25**  
**WELL SUMMARY**  
**SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

<b>WELL NAME</b>	<b>WELL LOCATION</b>	<b>ESTIMATED DEPTH (bgs)</b>	<b>ESTIMATED SCREENED INTERVAL (bgs)</b>
NTC22MW01S	Northwest of Building 105	25	15-25
NTC22MW02S	East of Building 105	25	15-25
NTC22MW03S	Inside Building 105, along cracks in floor	25	15-25
NTC22MW04S	Southwest of Building 105	25	15-25
NTC22MW05S	Inside the southern end of Building 105	25	15-25
NTC22MW06S	Former grease catch basin area	25	15-25
NTC22MW06D	Former grease catch basin area	50	40-50*
NTC22MW07S	East of former grease catch basin area	25	15-25
NTC22MW07D**	East of former grease catch basin area	50	40-50*
NTC22MW08S	Outside, southwest corner of Building 105	25	15-25
NTC22MW09S	South of Building 105	25	15-25

bgs = Below ground surface

\* The depth of the well will be determined in the field based on the lithology (identification of the confining layer), PID, and hydrophobic dye testing.

\*\* The location of this well will be determined based on the field observations during the drilling program.

**TABLE B-26**  
**GROUNDWATER SAMPLES**  
**SITE 22- BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

Well/ Sample Number	General Location	Analysis		
		TCL Chlorinated VOCs	Natural Attenuation Parameters <sup>(1)</sup>	Field Parameters <sup>(1)</sup>
GROUND WATER				
22MW01S	Northwest of Building 105	X	X	X
22MW02S	East of Building 205	X	-	X
22MW03S	Inside Building 205, along cracks in floor	X	X	X
22MW04S	Southwest of Building 205	X	-	X
22MW05S	Inside the southern end of Building 205	X	X	X
22MW06S	Former grease catch basin area	X	X	X
22MW06D	Former grease catch basin area	X	X	X
22MW07S	East of former grease catch basin area	X	-	X
22MW07D	East of former grease catch basin area	X	-	X
22MW08S	Outside, southwest corner of Building 205	X	-	X
22MW09S	South of Building 205	X	X	X

1 Natural attenuation parameters include: methane, ethane, ethane, dissolved iron and manganese, nitrate, nitrite, chloride, sulfate, sulfide, alkalinity, carbon dioxide, dissolved oxygen, hydrogen sulfide, ferrous iron, and total organic carbon.

2 Field parameters are pH, turbidity, specific conductance, dissolved oxygen, temperature, and oxidation-reduction potential (ORP).

VOCs = Volatile organic compounds

**TABLE B-27**  
**FIELD SAMPLE SUMMARY - GROUNDWATER**  
**SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**

Analysis	Methodology	Samples	Duplicates	Rinsate Blanks	Trip Blanks	Ambient Blanks	Matrix Spike/ Matrix Spike Duplicates	Total <sup>(1)</sup>
<b>Ground Water</b>								
TCL Chlorinated VOCs	SW-846 Method 8260B	11	1	1	3	NA	1	13
TCLP Organics (IDW samples only)	SW-846 Method 1311/8260B/8270C/8081A/8151A	2	0	NA	NA	NA	NA	2
TCLP Inorganics (IDW samples only)	SW-846 1311/6010B/7000A series	2	0	NA	NA	NA	NA	2
Methane, Ethane, Ethene	RSK SOP 147 and 175	6	1	NA	NA	NA	NA	7
Iron, Manganese	SW-846 6010B	6	1	NA	NA	NA	NA	7
Nitrate, Nitrite, Chloride, Sulfate	U.S. EPA 300.0 series	6	1	NA	NA	NA	NA	7
Sulfide	U.S. EPA 376.1	6	1	NA	NA	NA	NA	7
TOC	Walkley Black/SW-846 9060	6	1	NA	NA	NA	NA	7
Field natural attenuation parameters	Field Test Kits	6	1	NA	NA	NA	NA	7
Field parameters	Field Meter <sup>(2)</sup>	11	NA	NA	NA	NA	NA	11

1 Does not include the number of trip or ambient blanks.

2 Field parameters include temperature, pH, specific conductance, turbidity, ORP and dissolved oxygen.

TCL = Target Compound List

VOCs = Volatile organic compounds

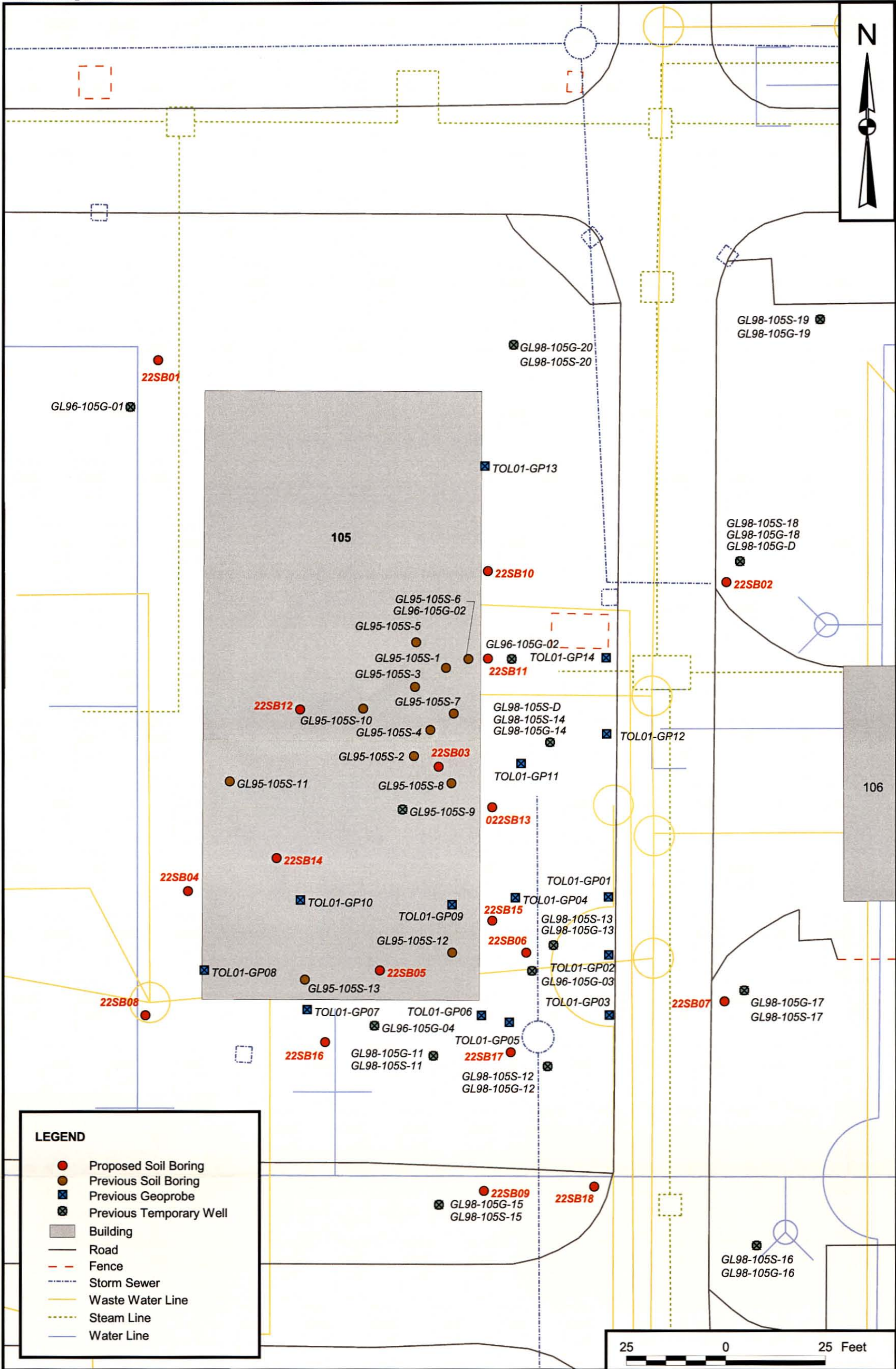
TOC = Total organic carbon

TCLP = Toxicity Characteristics Leaching Procedure

TBD = To be determined. Number of samples will be determined on site depending on conditions during sampling.

ORP = Oxidation-reduction potential

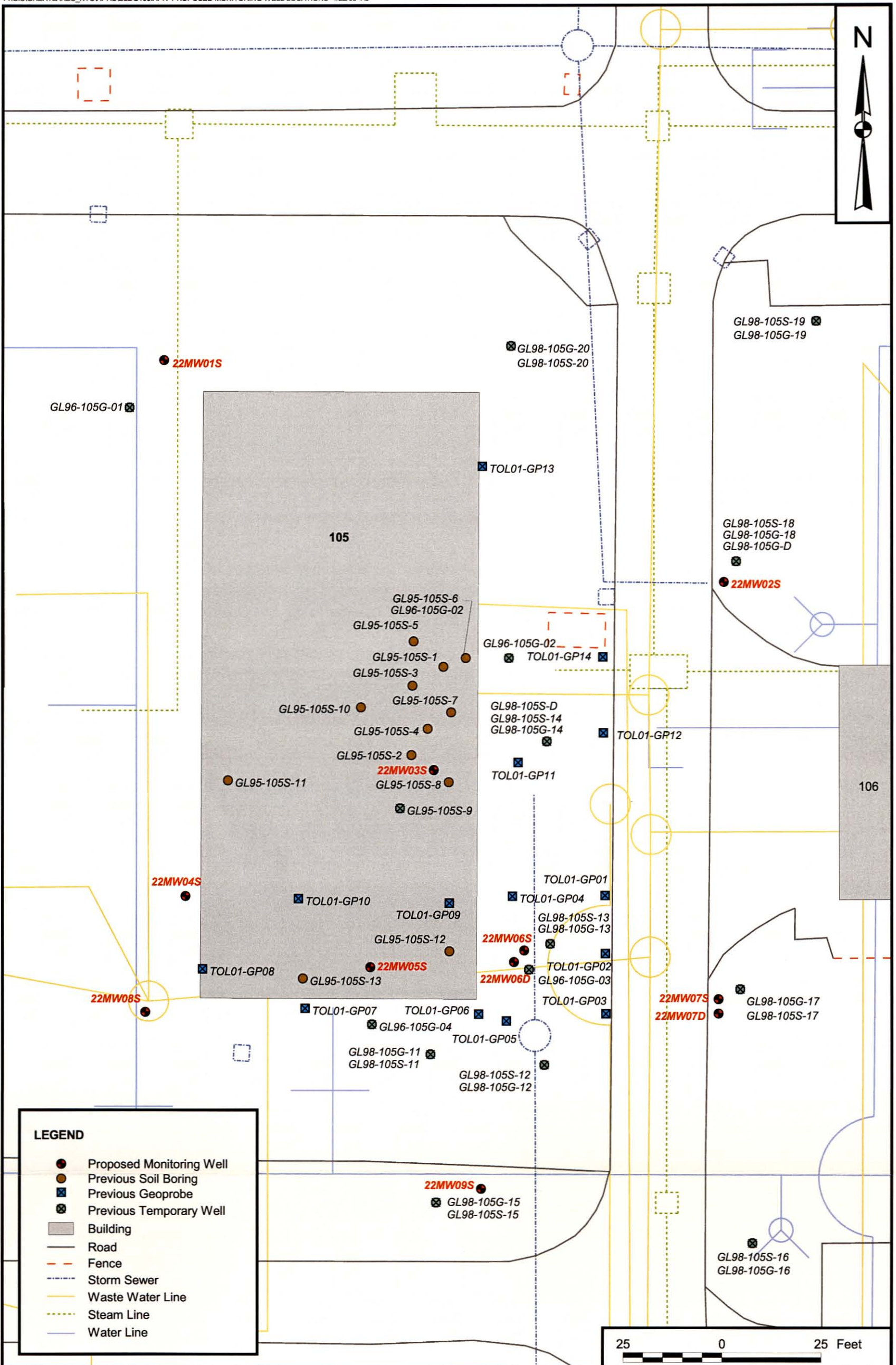
NA = Not applicable.




<b>DRAWN BY</b> J. LAMEY		<b>DATE</b> 4/14/03	
<b>CHECKED BY</b> F. WUDKWYCH		<b>DATE</b> 4/22/03	
<b>COST/SCHEDULE-AREA</b>			
<b>SCALE</b> AS NOTED			
<b>PROPOSED SOIL BORING LOCATIONS</b> SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS			
<b>CONTRACT NUMBER</b> N1474		<b>APPROVED BY</b> RFD	
<b>APPROVED BY</b>		<b>DATE</b> 4/22/03	
<b>DRAWING NO.</b> FIGURE B - 4		<b>REV</b> 0	

000149103051





DRAWN BY: J. LAMEY DATE: 4/14/03			PROPOSED MONITORING WELL LOCATIONS SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY NAVAL TRAINING CENTER GREAT LAKES, ILLINOIS		CONTRACT NUMBER N1474	
CHECKED BY: F. WUDKWYCH DATE: 4/22/03			APPROVED BY: RFD DATE: 4/22/03		APPROVED BY: _____ DATE: _____	
COST/SCHEDULE-AREA			DRAWING NO. FIGURE B - 5		REV 0	
SCALE: AS NOTED						

## REFERENCES

Illinois Environmental Protection Agency, 1996 Revised 2003. Tiered Approach to Corrective Action Objectives (TACO). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online February 2003.

Toltest, Inc., 2001. RCRA Closure Plan Building 105 (Former Dry Cleaner Facility) Great Lakes, Illinois. Department of the Navy, Naval Training Center Environmental Department, Great Lakes, Illinois. Contract No. N68950-00-D-0200, Delivery Order 0013. April.

U.S. Environmental Protection Agency (U.S. EPA), 2002. Region 9 Preliminary Remediation Goals (PRGs), U.S. EPA Region 9, 75 Hawthorne Street, San Francisco, California, 94105, October.

U.S. EPA, 2001. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24, Office of Solid Waste and Emergency Response. Washington, D.C.



## **APPENDIX I**

### **HUMAN HEALTH RISK ASSESSMENT WORK PLAN**

### **I.3 SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY**

## **SITE 22 - HUMAN HEALTH RISK ASSESSMENT METHODOLOGY**

This section is an addendum to Appendix I.1 of the existing Quality Assurance Project Plan (QAPP) (TtNUS, 2001) at NTC Great Lakes. The investigation at Site 22 – Building 105 Old Dry Cleaner Facility will be similar to the investigation at Site 7. The human health risk assessment methodology for Site 22 presented in the following sections will follow the methodology for Site 7 presented in Appendix I.1 of this QAPP, unless otherwise noted. Changes to the methodology specific to the investigation at Site 22 – Building 105 Old Dry Cleaning Facility are provided below

In addition to the documents used for Site 7, the following new or updated risk assessment guidance documents were used to develop the framework for the Baseline Human Health Risk Assessment:

- U.S. EPA, 2001. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24, Office of Solid Waste and Emergency Response. Washington, D.C.
- IEPA, 2003. TACO (Tiered Approach to Corrective Action Objectives). Illinois Environmental Protection Agency, Bureau of Land, available at <http://www.epa.state.il.us/land/taco/>, accessed online February 2003.

### **1.0 DATA EVALUATION**

Data evaluation for Site 22 will follow the methodology described in Section 1.0 of the Work Plan for Site 7 (Appendix I.1). However, the screening concentrations will be updated to reflect the most recent values provided by IEPA and the U. S. EPA. At the present time (May 2003), the screening criteria are based on the following:

#### **Screening Levels for Soil**

- IEPA Tier 1 Soil Remediation Objectives (IEPA, February 2003) for the soil ingestion exposure route and for the inhalation exposure route. The lowest Tier I objective of the receptors (residential, industrial/commercial, or construction worker) will be used for screening.
- U.S. EPA Region 9 Preliminary Remediation Goals (PRGs) for Residential Soil (U.S. EPA, October 2002).

- IEPA Tier 1 Soil Remediation Objectives for the Soil Component of the Groundwater Ingestion Exposure Route (IEPA, February 2003).
- U.S. EPA Region 3 Soil Screening Levels (SSLs) for Migration to Groundwater (U.S. EPA, October 2002).

### **Screening Concentrations for Groundwater**

- IEPA Tier 1 Groundwater Remediation Objectives for Class 1 Groundwater (IEPA, February 2003).
- U.S. EPA Region 9 PRGs for Tap Water (U.S. EPA, October 2002).
- U.S. EPA Maximum Contaminant Levels (MCLs) (U.S. EPA, Summer 2002).

### **Surface Water and Sediment**

Potential risks from exposure to surface water and sediment at Site 22 will not be evaluated because surface water and sediment do not exist on the site.

## **2.0 EXPOSURE ASSESSMENT**

The exposure assessment for Site 22 will follow the methodology described in Section 2.0 of the Work Plan for Site 7. The following sections provide information specific to the Site 22 risk assessment.

### **2.1 Conceptual Site Model**

The conceptual site model (CSM) for Site 22 is illustrated in Figure 1. The CSM will be refined during the risk assessment process using the data collected as part of the proposed field investigations. Table 1 presents a summary of the exposure routes that will be addressed quantitatively for each human receptor. The elements of the CSM as they pertain to Site 22 are presented in the following sections.

#### **2.1.1 Site Sources of Contamination**

Building 105 was constructed in 1939 and was utilized as a dry cleaning facility until 1993 or 1994 when it was converted to a vending machine supply and repair station. Soil and groundwater contamination is thought to have occurred via spills or leaks of chemicals associated with the dry cleaning process, especially PCE and its degradation products. PCE has been detected in historical soil samples at concentrations ranging from 10 to 1,500,000 ug/kg and in groundwater samples at concentrations ranging from 2 to 7,400 ug/L. Because of the high concentrations of VOCs detected in soil and groundwater, the

following additional (i.e., in addition to those evaluated for Site 7) exposure scenarios will be evaluated in the risk assessment for Site 22:

- Exposure of potential receptors [i.e., current worker receptor (full time commercial/industrial workers), trespassers, future residents] to vapors emitted from soil or groundwater in outdoor ambient air (Section 2.1.3.1).
- Exposure of hypothetical future on-site residents to vapors in indoor air. The vapors may be emitted from soil and/or groundwater (Section 2.1.3.2).
- Exposure of hypothetical future on-site workers (e.g., office workers) to vapors in buildings. The vapors may be emitted from soil and/or groundwater (Section 2.1.3.2).
- Exposure of hypothetical future on-site residents to vapors while showering with groundwater (Section 2.1.3.3).
- Exposure of future construction workers in a trench to vapors emitted from groundwater (see Section 2.1.3.4).

Exposure to fugitive dust and vapors from soil will also be evaluated semi-quantitatively by comparing maximum chemical concentrations in soil to IEPA TACO and U.S. EPA Generic SSLs for inhalation. If the maximum concentration of a chemical exceeds its SSL, potential risks from inhalation of that chemical will be quantitatively evaluated in the risk assessment according to guidance set forth in Risk Assessment Guidance for Superfund (RAGS) Part A (U.S. EPA, December 1989) and the U.S. EPA's Soil Screening Guidance (U.S. EPA, July 1996 and December 2002).

## **2.1.2 Potential Receptors**

Potential receptors at Site 22 include those described in Section 2.1.4 of the Site 7 Work Plan, plus one additional receptor, the future occupational worker. Therefore, the receptors evaluated for Site 22 include: maintenance workers, construction workers, occupational workers, adolescent trespassers, future military residents, and future civilian residents. Future occupational workers were added to account for the possibility that NTC might be developed for commercial/industrial uses at some future time and to provide information that may be necessary for risk management decisions. Occupational workers are assumed to be exposed to soil 219 days/year for 9 years for the Central Tendency Exposure (CTE) and 250 days/year for 25 years for the Reasonable Maximum Exposure (RME). To account for the possibility

that future workers might work inside buildings constructed on the site and inhale vapors emitted from soil or groundwater that migrate through cracks in building foundations and walls, these receptors will also be evaluated for inhalation of vapors inside buildings.

### 2.1.3 Chemical Intake Estimation

Future occupational workers will be added to the risk assessment for Site 22. These receptors are assumed to be exposed on the head, hands, and forearms (assuming that they wear a short-sleeved shirt, long pants, and shoes) for dermal contact with soil,. As recommended in RAGS Part E (U.S. EPA, September 2001), this skin surface area is assumed to be 3,300 cm<sup>2</sup> for the RME and CTE scenarios. This value represents the average of the 50<sup>th</sup> percentile areas of males and females more than 18 years old. The workers are assumed to ingest 100 mg/day of soil for the RME and 50 mg/day for the CTE and to inhale indoor and outdoor air at the rate of 20 m<sup>3</sup>/day.

As discussed in Section 2.1.1, several additional exposure scenarios have been added to the risk assessment for Site 22 to account for the inhalation of VOCs detected in historical samples at the site. Details of the inhalation exposure pathways are presented in the following subsections. Values of the exposure parameters and assumptions for the additional receptor and exposure pathways are presented in Tables 2 through 13.

#### 2.1.3.1 Inhalation of Outdoor Ambient Air Containing Volatiles Emitted from Groundwater

Potential receptors may be exposed to VOCs that have volatilized from groundwater, through soil, and into ambient air. Ambient air concentrations resulting from the volatilization of chemicals in groundwater to outdoor air will be calculated by using the following equation from American Society for Testing and Materials (ASTM) Standard Guide for Risk-Based Corrective Action (ASTM, 2000).

$$C_{air} = VF_{gw,amb} \cdot C_{gw} \cdot 10^3 \frac{L}{m^3}$$

where:  $C_{air}$  = chemical concentration in indoor air, mg/m<sup>3</sup>  
 $VF_{gw,amb}$  = volatilization factor from groundwater to indoor air, cm<sup>3</sup>-water/cm<sup>3</sup>-air  
 $C_{gw}$  = chemical concentration in groundwater, mg/L

The volatilization factor,  $VF_{gw,amb}$ , is calculated as follows:

$$VF_{gw} = \frac{1}{\left[ 1 + \frac{DF_{amb} \cdot L_{GW}}{D_{ws}^{eff}} \right]} \cdot \frac{1}{H'} \cdot 10^3 \cdot \frac{L}{m^3}$$

and

$$DF_{amb} = \frac{U_{air} \cdot W \cdot d_{air}}{A}$$

where:  $VF_{gw}$  = volatilization factor for groundwater, ( $L/m^3$ )  
 $H'$  = Henry's law constant, chemical specific, ( $cm^3 \cdot H_2O$ )/( $cm^3 \cdot air$ )  
 $L_{GW}$  = depth to groundwater, (cm)  
=  $h_v + h_{cap}$   
 $h_v$  = thickness of vadose zone, (cm)  
 $h_{cap}$  = thickness of capillary fringe; (cm)  
 $D_{ws}^{eff}$  = effective diffusion coefficient between groundwater and surface soil, chemical specific, ( $cm^2/sec$ )  
 $DF_{amb}$  = dispersion factor for outdoor air, (cm/sec)  
 $U_{air}$  = wind speed above ground surface in mixing zone, (cm/sec)  
 $d_{air}$  = ambient air mixing zone, (cm)  
 $W$  = width of source parallel to groundwater flow direction, (cm)  
 $A$  = source-zone area, ( $cm^2$ )

The effective diffusion coefficient between groundwater and surface soil,  $D_{ws}^{eff}$ , is calculated as follows:

$$D_{ws}^{eff} = \frac{L_{gw}}{(h_v/D_v^{eff}) + (h_{cap}/D_{cap}^{eff})}$$

Where:  $D_{cap}^{eff}$  = effective diffusion through capillary fringe, chemical specific,  $cm^2/sec$   
 $D_v^{eff}$  = effective diffusion in vadose zone soil based on vapor-phase concentration, chemical specific,  $cm^2/sec$

The effective diffusion through the capillary fringe,  $D_{cap}^{eff}$ , is calculated from:

$$D_{cap}^{eff} = D^{air} \cdot \frac{\theta_{acap}^{3.33}}{\theta_T^2} + D^{wat} \cdot \frac{1}{H} \cdot \frac{\theta_{wcap}^{3.33}}{\theta_T^2}$$

where:  $D^{air}$  = diffusion coefficient in air, chemical specific,  $cm^2/sec$   
 $D^{wat}$  = diffusion coefficient in water, chemical specific,  $cm^2/sec$   
 $\theta_{acap}$  = volumetric air content in capillary fringe soils,  $0.038 \text{ cm}^3\text{-air}/\text{cm}^3\text{-soil}$   
 $\theta_{wcap}$  = volumetric water content in capillary fringe soils,  $0.342 \text{ cm}^3\text{-H}_2\text{O}/\text{cm}^3\text{-soil}$   
 $\theta_T$  = total soil porosity,  $0.38 \text{ cm}^3/\text{cm}^3\text{-soil}$

Input assumptions for the volatilization from groundwater to outdoor air model will be presented in an appendix to the risk assessment. Site-specific values will be used whenever possible. Model default values will be used when they are believed to be representative of site conditions. Chemical properties will be obtained primarily from the Soil Screening Guidance: User's Guide (U.S. EPA, July 1996 and March 2001). Other possible sources of chemical/physical data include the Superfund Chemical Data Matrix (SCDM), the U.S. EPA's CHEMDAT8 and WATER8 models, the Hazardous Substance Data Base (HSDB) (<http://toxnet.nlm.nih.gov>), and the Risk Assessment Information System (RAIS), Office of Environment (<http://risk.lsd.ornl.gov>).

Intakes of vapors from groundwater will be calculated using the air concentration estimated by the above model and the following equation (U.S. EPA, December 1989):

$$\text{Intake}_{air} = (C_{air})(IR_a)(ET)(EF)(ED) / (BW)(AT)$$

where:  $\text{Intake}_{ai}$  = intake of chemical "i" from air via inhalation (mg/kg/day)  
 $C_{air}$  = concentration of chemical "i" in air ( $mg/m^3$ ) (calculated)  
 $IR_a$  = inhalation rate ( $m^3/hr$ )  
 $ET$  = exposure time (hours/day)  
 $EF$  = exposure frequency (days/yr)  
 $ED$  = exposure duration (yr)  
 $BW$  = body weight (kg)  
 $AT$  = averaging time (days)  
 for noncarcinogens,  $AT = ED \times 365 \text{ days/yr}$   
 for carcinogens,  $AT = 70 \text{ yrs} \times 365 \text{ days/yr}$



An inhalation rate of 20 m<sup>3</sup>/day (U.S. EPA, December 2002) will be used to calculate the inhalation intake for current worker receptor (full time commercial/industrial workers), maintenance workers, future occupational workers, and future adult residents. The inhalation rates for adolescent trespassers will be 1.9 m<sup>3</sup>/hour for the RME and 1.2 m<sup>3</sup>/hour for the CTE (U.S. EPA, August 1997).

#### 2.1.3.2 Inhalation of Volatiles from Soil and Groundwater inside Buildings by Vapor Intrusion

Volatilization of chemicals from soil and groundwater into indoor air may occur, thereby exposing individuals inside buildings or dwellings. Therefore, potential risks associated with chemical concentrations in indoor air as a result of vapor migration from impacted soil or groundwater will be evaluated for hypothetical future on-site residents. The Johnson and Ettinger Vapor Intrusion Model (U.S. EPA, December 2000) will be used to determine the indoor air concentration of a chemical that is present in groundwater. The model assumes that vapors of volatile chemicals are emitted from soil or groundwater, migrate through cracks in building foundations, and accumulate in air inside buildings. The Johnson and Ettinger Model assumes that residential dwellings or commercial buildings have been constructed on the site and that the dimensions and ventilation rates of these buildings are typical of residential dwellings in the United States.

The volatility of a chemical largely determines the significance of this route of exposure. Indoor air concentrations of a chemical will be influenced by the physical and chemical properties of the substance, especially solubility and vapor pressure. Low aqueous solubilities and high vapor pressures increase the likelihood that organic compounds found in water will also be found in indoor air. Additionally, the physical properties of the soil can have a great influence on the rate of diffusion of chemicals through the soil.

The following equation is used to assess intakes for inhalation of indoor air:

$$\text{Intake} = \frac{\text{IR}_a \times \text{EF} \times \text{ED} \times \text{C}_{\text{building}}}{\text{AT} \times \text{BW}}$$

where: Intake = intake of chemical from air (mg/kg-day)  
 IR<sub>a</sub> = inhalation rate (m<sup>3</sup>/day)  
 EF = exposure frequency (days/year)  
 ED = exposure duration (years)

$C_{\text{building}}$  = vapor concentration in the building ( $\text{mg}/\text{m}^3$ ) as calculated by the model

AT = averaging time (days)  
 for noncarcinogens,  $\text{AT} = \text{ED} \times 365 \text{ days/year}$   
 for carcinogens,  $\text{AT} = 70 \text{ years} \times 365 \text{ days/year}$

BW = body weight (kg)

A discussion of the major assumptions and limitations of the Johnson and Ettinger Model will be provided in the uncertainty section of the risk assessment. Additional assumptions are contained in Section 5 of the Model Users Guide (U.S. EPA, December 2000). Indoor inhalation rates are set at  $20 \text{ m}^3/\text{day}$  for adult residents and occupational workers (U.S. EPA, December 2002) and  $10 \text{ m}^3/\text{day}$  for child residents (USEPA, August 1997).

#### 2.1.3.3 Inhalation of Volatiles in Groundwater While Showering

Groundwater exposure may also result in inhalation of volatiles, typically for residential receptors who may be exposed while showering, bathing, washing dishes, etc. Inhalation exposures are estimated using a mass transfer model developed specifically for this exposure route in combination with an air intake estimation model. The mass transfer model accounts for inhalation that occurs during a shower and after a shower while the receptor remains in the closed bathroom. The method used is as follows (Foster and Chrostowski, 1987):

$$\text{Intake}_{\text{si}} = (S)(\text{IR}_{\text{sh}})(K)(\text{EF})(\text{ED}) / (\text{BW})(\text{AT})(R_a)(\text{CF})$$

$$K = D_s + \frac{\exp(-R_a \times D_t)}{R_a} - \frac{\exp(R_a \times (D_s - D_t))}{R_a}$$

where:  $\text{Intake}_{\text{wi}}$  = intake of chemical "i" from water via inhalation ( $\text{mg}/\text{kg}/\text{day}$ )

S = volatile chemical generation rate ( $\text{ug}/\text{m}^3\text{-min}$  - shower)

$\text{IR}_{\text{sh}}$  = inhalation rate ( $\text{L}/\text{min}$ )

K = mass transfer coefficient (min)

EF = exposure frequency (showers/yr)

ED = exposure duration (yr)

BW = body weight (kg)

AT = averaging time or period of exposure (days)

$R_a$	=	air exchange rate ( $\text{min}^{-1}$ )
CF	=	conversion factor ( $1 \times 10^6 \text{ ug-L/mg-m}^3$ )
$D_s$	=	shower duration (min)
$D_t$	=	total time in bathroom (min)

The estimated volatile chemical generation rate is based on two-phase film theory. The model uses contaminant-specific mass transfer coefficients, Henry's Law constants, droplet diameter, drop time, viscosity, and temperature. Shower inhalation rates are set at 10 L/min for adult and child residents (U.S. EPA, 1989). The shower model calculations will be presented in an appendix to the risk assessment.

#### 2.1.3.4 Exposure of Workers to Volatiles in a Construction/Utility Trench

There are no well-established models available for estimating migration of volatiles from groundwater into a construction/utility trench. This risk assessment will use an approach suggested by the Virginia Department of Environmental Quality (VDEQ, online September 2002) that is based on a combination of a vadose zone model to estimate volatilization of gases from contaminated groundwater into a trench and a box model to estimate dispersion of the contaminants from the air inside the trench into the above-ground atmosphere to estimate the exposure point concentration (EPC) for air in a construction trench. The VDEQ methodology is described in the following sections.

The airborne concentration of a contaminant in a trench can be estimated using the following equation:

$$C_{\text{trench}} = C_{\text{GW}} \times \text{VF}$$

where:  $C_{\text{trench}}$  = air concentration of contaminant in the trench ( $\text{ug/m}^3$ )

$C_{\text{GW}}$  = concentration of contaminant in groundwater ( $\text{ug/L}$ )

VF = volatilization factor ( $\text{L/m}^3$ )

The model used in this risk assessment assumes that a construction project could result in an excavation to 15 feet bgs or less. If the depth to groundwater at a site is less than 15 feet, the VDEQ model assumes that a worker would encounter groundwater when digging an excavation or a trench. The worker would then have direct exposure to the groundwater. The worker would also be exposed to contaminants in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench.

The following equation is used to calculate VF for a trench less than 15 feet deep:

$$VF = (K_i \times A \times F \times 10^{-3} \times 10^4 \times 3,600) / (ACH \times V)$$

where:  $K_i$  = overall mass transfer coefficient of contaminant (cm/s)

$A$  = area of the trench ( $m^2$ )

$F$  = fraction of floor through which contaminant can enter (unitless)

$ACH$  = air changes per hour =  $360\ h^{-1}$

$V$  = volume of trench ( $m^3$ )

$10^{-3}$  = conversion factor ( $L/cm^3$ )

$10^4$  = conversion factor ( $cm^2/m^2$ )

$3,600$  = conversion factor (seconds/hr)

Studies of urban canyons suggest that if the ratio of trench width to trench depth, relative to wind direction, is less than or equal to 1, a circulation cell or cells will be set up within the trench that limits the degree of gas exchange with the atmosphere and the ACH is assumed to be of 2/hr based on measured ventilation rates of buildings. If the ratio of trench width to trench depth is greater than one, air exchange between the trench and above-ground atmosphere is not restricted, and ACH is assumed to be 360/hr based upon the ratio of trench depth to the average wind speed. This risk assessment assumes that the width to trench depth ratio is greater than 1. The use of this width-to-trench ratio is appropriate for Site 22 because it would be more applicable to excavating building foundations than to working in narrower spaces. Therefore, ACH is assumed to be  $360\ h^{-1}$ .

The overall mass transfer coefficient ( $K_i$ ) is calculated as follows:

$$K_i = 1 / \{ (1/k_iL) + [(RT) / (H_i k_iG)] \}$$

where:  $k_iL$  = liquid-phase mass transfer coefficient of  $i$  cm/s

$R$  = ideal gas constant ( $atm \cdot m^3 / mole \cdot ^\circ K$ ) =  $8.2 \times 10^{-5}$

$T$  = average system absolute temperature ( $^\circ K$ ) (Default =  $298^\circ K$ )

$H_i$  = Henry's Law constant of  $i$  ( $atm \cdot m^3 / mol$ )

$k_iG$  = gas-phase mass transfer coefficient of  $i$  (cm/s)

where:  $kiL = (MWO_2 / MWi)^{0.5} \times (T / 298) \times kL_{O_2}$

$k_iL$  = liquid-phase mass transfer coefficient of component  $i$  (cm/s)

$MWO_2$  = molecular weight of  $O_2$  (g/mol)

$MW_i$  = molecular weight of component i (g/mol)

$kL, O_2$  = liquid-phase mass transfer coefficient of oxygen at 25°C (cm/s)

The value of  $kL, O_2$  is 0.002 cm/s.

$$k_iG = (MWH_2O/MW_i)^{0.335} \times (T/298)^{1.005} \times kG, H_2O$$

where:  $k_iG$  = gas-phase mass transfer coefficient of component i (cm/s)

$MWH_2O$  = molecular weight of water (g/mol)

$kG, H_2O$  = gas-phase mass transfer coefficient of water vapor at 25°C (cm/s)

The value of  $kG, H_2O$  is 0.833 cm/s (Superfund Exposure Assessment Manual, U. S. EPA, April 1988)

Exposures for construction workers associated with the inhalation route are estimated in the following manner (U.S. EPA, December 1989):

$$\text{Intake}_{ai} = \frac{(C_{ai})(IR_a)(ET)(EF)(ED)}{(BW)(AT)}$$

where:  $\text{Intake}_{ai}$  = intake of chemical "i" from air via inhalation (mg/kg/day)

$C_{ai}$  = concentration of chemical "i" in air (mg/m<sup>3</sup>)

$IR_a$  = inhalation rate (m<sup>3</sup>/hr) = 2.5 m<sup>3</sup>/hr (U.S. EPA, December 2002)

$ET$  = exposure time (hours/day)

$EF$  = exposure frequency (days/yr)

$ED$  = exposure duration (yr)

$BW$  = body weight (kg)

$AT$  = averaging time (days)

for noncarcinogens,  $AT = ED \times 365 \text{ days/yr}$

for carcinogens,  $AT = 70 \text{ yr} \times 365 \text{ days/yr}$

Input assumptions for the volatilization from groundwater to outdoor air model will be presented in an appendix to the risk assessment. Site-specific values will be used whenever possible. Model default values will be used when they are believed to be representative of site conditions. Chemical properties will be obtained from the Soil Screening Guidance (U.S. EPA, December 2001) and will be presented with the model calculations.

### **2.3 Exposure Point Concentrations (EPCs)**

The exposure concentration, calculated for COPCs only, is a reasonable maximum estimate of the chemical concentration that is likely to be contacted over time by a receptor and is used to calculate estimated exposure intakes. The 95 percent upper confidence limit (UCL), which is based on the distribution of a data set, is considered to be the best estimate of the exposure concentration for data sets with 10 or more samples (U.S. EPA, 1992). The 95 percent UCL will be used as the exposure concentration to assess RME and CTE risks (U.S. EPA, 1993a). For data sets with less than 10 samples, the UCL is considered to be a poor estimate of the mean, and the exposure concentration will be defined as the maximum concentration.

Conventional statistical methods (i.e., the Shapiro-Wilk W-Test) will be used to determine the distribution and UCL of a particular data set (Gilbert, 1987; U.S. EPA, 1992). Detailed sample calculations, as well as general methodology for the statistical evaluation, will be presented in the site-specific risk assessments. Non-detected data points will be utilized; in general, one-half the sample-specific detection limit will be employed for these analytical results.

The following guidelines will be used to calculate the EPCs:

- If a data set contains less than 10 samples, the EPC for the RME and CTE cases will be defined as the maximum detected concentration.
- If a data set contains 10 or more samples, the 95 percent UCL on the arithmetic mean, based on the distribution of the data set, will be selected as the EPC for the RME and CTE cases. Conventional statistical methods (e.g., the Shapiro-Wilk W-Test, the t- and H-statistic based UCL calculation) will initially be used to determine the distribution and UCL. The “best fit” distribution (normal or lognormal) will initially be assumed if the data set distribution is undefined. However, if the risk assessor or statistician determines that assumptions about the distributional type cannot reasonably be made or if the data contains large proportions of non-detects, methods provided in the U.S. EPA guidance “Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites” (U.S. EPA, December 2002) will be used to evaluate the data. This may involve the use of distribution-free or nonparametric methods, if applicable. EPCs calculated assuming a lognormal distribution will be reviewed and re-calculated (if necessary), as recommended in U.S. EPA guidance (U.S. EPA, 1997b) so that the H-statistic based UCL is not an over-prediction of the EPC. If the calculated 95 percent UCL exceeds the maximum detected concentration, the maximum

concentration will be used as the EPC. If enough data are available and a qualified statistician judges that Jackknife or Bootstrap procedures would present a more realistic estimation of risk, these techniques, which are described in the U.S. EPA (1997b) reference, may be used. Bootstrap and Jackknife procedures are nonparametric statistical techniques which can be used to reduce the bias of point estimates and construct approximate confidence intervals for parameters such as the population mean. These procedures require no assumptions regarding the statistical distribution (e.g., normal or lognormal) of the data and can be applied to a variety of situations, no matter how complicated. The Bootstrap and Jackknife procedures, which are based on resampling techniques, are conceptually simple but require considerable computing power and time.

### **3.0 TOXICITY ASSESSMENT**

The toxicity assessment for Site 22 will be similar to that of Site 7. However, the toxicity discussion will be adapted to account for the types of chemicals detected at Site 22 and for the additional exposure scenarios described above. For example, chronic noncancer toxicity values (RfDs) will be used for most exposure scenarios but subchronic RfDs will be used for the construction workers scenarios. Toxicological profiles for each COPC will be presented in an appendix to the risk assessment. These brief profiles will present a summary of the currently available literature on the carcinogenic and noncarcinogenic health effects associated with human exposure to the COPCs.

This page intentionally left blank.



**SITE 22 - TABLE 1**

**EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION  
SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY  
NTC GREAT LAKES, ILLINOIS**

<b>Receptors</b>	<b>Exposure Routes</b>
Maintenance Workers (current/future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact</li> <li>• Soil Ingestion</li> <li>• Inhalation of Air/Dust/Emissions (from soil)</li> <li>• Inhalation of Outdoor Ambient Air (vapors from groundwater)</li> </ul>
Adolescent Trespassers (7 to 16 Years) (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact</li> <li>• Soil Ingestion</li> <li>• Inhalation of Air/Dust/Emissions (from soil)</li> <li>• Inhalation of Outdoor Ambient Air (vapors from groundwater)</li> </ul>
Construction Workers (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact</li> <li>• Soil Ingestion</li> <li>• Inhalation of Air/Dust/Emissions (from soil)</li> <li>• Groundwater Dermal Contact (during excavation)</li> <li>• Groundwater Inhalation of Volatile Organics (during excavation)</li> </ul>
Occupational Workers (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact</li> <li>• Soil Ingestion</li> <li>• Inhalation of Air/Dust/Emissions (from soil)</li> <li>• Inhalation of Outdoor Ambient Air (vapors from groundwater)</li> <li>• Inhalation of Indoor Air (vapors from soil and groundwater)</li> </ul>
On-Base Military Residents (Adult/Children) (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact</li> <li>• Soil Ingestion</li> <li>• Inhalation of Air/Dust/Emissions (from soil)</li> <li>• Inhalation of Outdoor Ambient Air (vapors from groundwater)</li> <li>• Inhalation of Indoor Air (vapors from soil and groundwater)</li> </ul>
On-site Civilian Residents (Adult/Children) (future land use)	<ul style="list-style-type: none"> <li>• Soil Dermal Contact</li> <li>• Soil Ingestion</li> <li>• Inhalation of Air/Dust/Emissions (from soil)</li> <li>• Inhalation of Outdoor Ambient Air (vapors from groundwater)</li> <li>• Inhalation of Indoor Air (vapors from soil and groundwater)</li> </ul>

**SITE 22 - TABLE 2**

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF OCCUPATIONAL WORKERS TO SOIL  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Entire Site  
Receptor Population: Occupational Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Ingestion	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	U.S. EPA, May 1993	95% UCL or Max	U.S. EPA, May 1993	$\text{Ingestion CDI}^{(1)} (\text{mg/kg/day}) = \frac{\text{Csoil} \times \text{IR} \times \text{FI} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$ U.S. EPA, December 1989
	IR	Ingestion Rate of Soil	mg/day	100	U.S. EPA, May 1993	50	U.S. EPA, May 1993	
	FI	Fraction Ingested	unitless	1.0	U.S. EPA, May 1993	1.0	U.S. EPA, May 1993	
	EF	Exposure Frequency	days/year	250	U.S. EPA, May 1993	219	U.S. EPA, May 1993	
	ED	Exposure Duration	years	25	U.S. EPA, May 1993	9	U.S. EPA, May 1993	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA, December 1989	1.0E-06	U.S. EPA, December 1989	
	BW	Body Weight	kg	70	U.S. EPA, May 1993	70	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
Dermal	AT-N	Averaging Time (Non-Cancer)	days	9,125	U.S. EPA, December 1989	3,285	U.S. EPA, December 1989	$\text{Dermal CDI}^{(1)} (\text{mg/kg/day}) = \frac{\text{Csoil} \times \text{CF} \times \text{SA} \times \text{AF} \times \text{ABS} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$ U.S. EPA, December 1989
	Csoil	Chemical Concentration in Soil	mg/kg	95% UCL or Max	U.S. EPA, May 1993	95% UCL or Max	U.S. EPA, May 1993	
	CF	Conversion Factor	kg/mg	1.0E-06	U.S. EPA, December 1989	1.0E-06	U.S. EPA, December 1989	
	SA	Skin Surface Area	cm <sup>2</sup> /day	3,300	U.S. EPA, September 2001	3,300	U.S. EPA, September 2001	
	AF	Soil to Skin Adherence Factor	mg/cm <sup>2</sup>	0.2	U.S. EPA, September 2001	0.02	U.S. EPA, September 2001	
	ABS	Dermal Absorption Factor (Solid)	unitless	chemical -specific	U.S. EPA, September 2001	chemical -specific	U.S. EPA, September 2001	
	EF	Exposure Frequency	days/year	250	U.S. EPA, May 1993	219	U.S. EPA, May 1993	
	ED	Exposure Duration	years	25	U.S. EPA, May 1993	9	U.S. EPA, May 1993	
	BW	Body Weight	kg	70	U.S. EPA, May 1993	70	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	9,125	U.S. EPA, December 1989	3,285	U.S. EPA, December 1989	

1 CDI = Chronic Daily Intake  
RME = Reasonable Maximum Exposure  
CTE = Central Tendency Exposure  
UCL = 95 Percent Upper Confidence Limit

SITE 22 - TABLE 3

**VALUES USED FOR DAILY INTAKE CALCULATIONS FOR EXPOSURE OF  
CONSTRUCTION WORKERS TO SURFACE / SUBSURFACE SOIL  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil  
Exposure Medium: Soil  
Exposure Point: Surface / Subsurface Soil  
Receptor Population: Construction Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Cs	Chemical Concentration in Soil	(mg/kg)	95% UCL	U.S. EPA 1993a	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $C_s \times I R_s \times C F \times F I \times E F \times E D$ BW x AT
	IRs	Ingestion Rate of Soil	(mg/day)	480	U.S. EPA 1993a	240	U.S. EPA 1993a	
	EF	Exposure Frequency	(days/year)	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	
	FI	Fraction Ingested	(unitless)	1	Professional Judgement	1	Professional Judgement	
	ED	Exposure Duration	(year)	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	210	U.S. EPA 1989	210	U.S. EPA 1989	
Dermal	Cs	Chemical Concentration in Soil	(mg/kg)	95%UCL	U.S. EPA 1993	95%UCL	U.S. EPA 1993a	Chronic Daily Intake (CDI) (mg/kg-day) = $C_s \times S A \times C F \times A B S \times A F \times E F \times E D$ BW x AT
	AF	Soil to Skin Adherence Factor	(mg/cm <sup>2</sup> )	0.3	U.S. EPA 2000	0.1	U.S. EPA 2000a	
	SA	Skin Surface Area	(cm <sup>2</sup> )	5,800	U.S. EPA 1997	5,000	U.S. EPA 1997a	
	ABS	Absorption Factor	(unitless)	chemical-specific	U.S. EPA 2000a	chemical-specific	U.S. EPA 2000a	
	EF	Exposure Frequency	(days/year)	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	
	ED	Exposure Duration	(year)	1	Professional Judgement	1	Professional Judgement	
	CF	Conversion Factor	(kg/mg)	1.00E-06	U.S. EPA 1989	1.00E-06	U.S. EPA 1989	
	BW	Body Weight	(kg)	70	U.S. EPA 1989	70	U.S. EPA 1989	
	AT-C	Averaging Time (Cancer)	(days)	25,550	U.S. EPA 1989	25,550	U.S. EPA 1989	
	AT-N	Averaging Time (Noncancer)	(days)	210	U.S. EPA 1989	210	U.S. EPA 1989	

UCL - 95 percent upper confidence limit calculated according to Supplemental Guidance to RAGS: Calculating the Concentration Term, May 1992. PB92-963373.

U.S. EPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

U.S. EPA, 1993a: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

Office of Solid Waste and Emergency Response, Washington, DC. May.

U.S. EPA, 1997a: Exposure Factors Handbook, EPA/600/P-95/002Fa/, Office of Research and Development, August.

U.S. EPA, 2000a: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Interim Guidance.

## SITE 22 - TABLE 4

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF MAINTENANCE WORKERS TO OUTDOOR AMBIENT AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Air  
Exposure Point: Outdoor Ambient Air  
Receptor Population: Maintenance Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	ASTM E 2081-00	Derived	ASTM E 2081-00	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I_{Ra} \times ET \times EF \times ED$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /hr	2.5	U.S. EPA, August 1997	1.5	U.S. EPA, August 1997	
	EF	Exposure Frequency	days/year	24	Professional Judgement (2 days per month)	12	Professional Judgement (1/2 the RME )	
	ED	Exposure Duration	years	25	U.S. EPA, May 1993	9	U.S. EPA, May 1993	
	ET	Exposure Time	hr/day	8	Professional judgement	4	Professional judgement	
	BW	Body Weight	kg	70	U.S. EPA, December 1989	70	U.S. EPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	9,125	U.S. EPA, December 1989	3,285	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

SITE 22 - TABLE 5

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF OCCUPATIONAL WORKERS TO OUTDOOR AMBIENT AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Air  
Exposure Point: Outdoor Ambient Air  
Receptor Population: Occupational Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	ASTM E 2081-00	Derived	ASTM E 2081-00	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I_{Ra} \times E_T \times E_F \times E_D$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /hr	2.5	U.S. EPA, March 2001	1.3	U.S. EPA, August 1997	
	EF	Exposure Frequency	days/year	250	U.S. EPA, May 1993	219	U.S. EPA, May 1993	
	ED	Exposure Duration	years	25	U.S. EPA, May 1993	9	U.S. EPA, May 1993	
	ET	Exposure Time	hr/day	8	U.S. EPA, December 2002	4	Professional judgement	
	BW	Body Weight	kg	70	U.S. EPA, December 1989	70	U.S. EPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	9,125	U.S. EPA, December 1989	3,285	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

SITE 22 - TABLE 6

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF ADOLESCENT TRESPASSERS TO OUTDOOR AMBIENT AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Air  
Exposure Point: Outdoor Ambient Air  
Receptor Population: Trespassers  
Receptor Age: Adolescent (7 to 16 years old)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	ASTM E 2081-00	Derived	ASTM E 2081-00	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I_{Ra} \times ET \times EF \times ED$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /hr	1.9	U.S. EPA, August 1997	1.2	U.S. EPA, August 1997	
	EF	Exposure Frequency	days/year	26	Professional Judgement (1 day per week in warm weather months)	13	Professional Judgement (1/2 the RME )	
	ED	Exposure Duration	years	10	Adolescent, Age 7 - 16	10	Adolescent, Age 7 - 16	
	ET	Exposure Time	hr/day	2	Professional judgement	1	Professional judgement	
	BW	Body Weight	kg	42	U.S. EPA, August 1997	42	U.S. EPA, August 1997	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	3,650	U.S. EPA, December 1989	3,650	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

SITE 22 - TABLE 7

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF FUTURE ADULT RESIDENTS TO OUTDOOR AMBIENT AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Air  
Exposure Point: Outdoor Ambient Air  
Receptor Population: Resident  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	ASTM E 2081-00	Derived	ASTM E 2081-00	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /day	20	U.S. EPA, August 1997	20	U.S. EPA, August 1997	$C_{air} \times IR_a \times ET \times EF \times ED$
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	$BW \times AT$
	ED	Exposure Duration	years	24	U.S. EPA, May 1993	7	U.S. EPA, May 1993	
	BW	Body Weight	kg	70	U.S. EPA, December 1989	70	U.S. EPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	8,760	U.S. EPA, December 1989	2,555	U.S. EPA, December 1989	

Note: The same exposure parameters are used for civilian and military adult residents, with the exception of exposure duration (ED).

Adult military residents are assumed to be exposed for a period of 6 years for the RME and CTE.

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

SITE 22 - TABLE 8

VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF FUTURE CHILD RESIDENTS TO OUTDOOR AMBIENT AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Air  
Exposure Point: Outdoor Ambient Air  
Receptor Population: Resident  
Receptor Age: Child (0-6 Years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	ASTM E 2081-00	Derived	ASTM E 2081-00	Chronic Daily Intake (CDI) (mg/kg-day)= $\frac{C_{air} \times I_{Ra} \times E_T \times E_F \times E_D}{BW \times AT}$
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /day	10	U.S. EPA, August 1997	10	U.S. EPA, August 1997	
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	
	ED	Exposure Duration	years	6	U.S. EPA, May 1993	2	U.S. EPA, May 1993	
	BW	Body Weight	kg	15	U.S. EPA, May 1993	15	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	2,190	U.S. EPA, December 1989	730	U.S. EPA, December 1989	

Note: The same exposure parameters are used for civilian and military child residents.

RME = Reasonable Maximum Exposure  
CTE = Central Tendency Exposure



## SITE 22 - TABLE 9

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF OCCUPATIONAL WORKERS TO INDOOR AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil/Groundwater  
Exposure Medium: Air  
Exposure Point: Indoor Air  
Receptor Population: Occupational Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	ASTM E 2081-00	Derived	ASTM E 2081-00	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I_{Ra} \times ET \times EF \times ED$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /hr	2.5	U.S. EPA, December 2002	2.5	U.S. EPA, March 2001	
	EF	Exposure Frequency	days/year	250	U.S. EPA, May 1993	219	U.S. EPA, May 1993	
	ED	Exposure Duration	years	25	U.S. EPA, May 1993	9	U.S. EPA, May 1993	
	ET	Exposure Time	hr/day	8	U.S. EPA, December 2002	8	Professional judgement	
	BW	Body Weight	kg	70	U.S. EPA, December 1989	70	U.S. EPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	9,125	U.S. EPA, December 1989	3,285	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

## SITE 22 - TABLE 10

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF FUTURE ADULT RESIDENTS TO INDOOR AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil/Groundwater  
Exposure Medium: Air  
Exposure Point: Indoor Air  
Receptor Population: Resident  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	USEPA, December 2000	Derived	USEPA, December 2000	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I_{Ra} \times ET \times EF \times ED$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /day	20	USEPA, August 1997	20	USEPA, August 1997	
	EF	Exposure Frequency	days/year	350	USEPA, May 1993	234	USEPA, May 1993	
	ED	Exposure Duration	years	24	USEPA, May 1993	7	USEPA, May 1993	
	BW	Body Weight	kg	70	USEPA, December 1989	70	USEPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	8,760	USEPA, December 1989	2,555	USEPA, December 1989	

Note: The same exposure parameters are used for civilian and military adult residents, with the exception of exposure duration (ED).  
Adult Military residents are assumed to be exposed for a period of 6 years for the RME and CTE.

RME = Reasonable Maximum Exposure  
CTE = Central Tendency Exposure

**SITE 22 - TABLE 11**

**VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF FUTURE CHILD RESIDENTS TO INDOOR AIR  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
Medium: Soil/Groundwater  
Exposure Medium: Air  
Exposure Point: Indoor Air  
Receptor Population: Resident  
Receptor Age: Child (0-6 Years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/Reference	CTE Value	CTE Rationale/Reference	Intake Equation/Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	U.S. EPA, December 2000	Derived	U.S. EPA, December 2000	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I_{Ra} \times ET \times EF \times ED$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /day	10	U.S. EPA, August 1997	10	U.S. EPA, August 1997	
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	
	ED	Exposure Duration	years	6	U.S. EPA, May 1993	2	U.S. EPA, May 1993	
	BW	Body Weight	kg	15	U.S. EPA, May 1993	15	U.S. EPA, May 1993	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	2,190	U.S. EPA, December 1989	730	U.S. EPA, December 1989	

Note: The same exposure parameters are used for civilian and military child residents.

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

**SITE 22 - TABLE 12**

**VALUES USED FOR DAILY INTAKE CALCULATIONS**

**EXPOSURE OF FUTURE ADULT RESIDENTS TO VAPORS FROM GROUNDWATER WHILE SHOWERING**

**SITE 22 - BUILDING 105**

**NTC, GREAT LAKES, ILLINOIS**

Scenario Timeframe: Future  
 Medium: Groundwater  
 Exposure Medium: Groundwater  
 Exposure Point: Tap Water  
 Receptor Population: Resident  
 Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	S	Volatile Chemical Generation Rate	ug/m <sup>3</sup> -min shower	Derived	Foster&Chrostowski , 1987	Derived	Foster&Chrostowski , 1987	Chronic Daily Intake (CDI) (mg/kg-day)=
	IRsh	Inhalation Rate of Volatiles in Shower	L/min	10	U.S. EPA, December 1989	10	U.S. EPA, December 1989	$S \times IRsh \times K \times EF \times ED$
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	$BW \times AT \times Ra \times CF$
	K	Mass Transfer Coefficient	min	Derived	Foster&Chrostowski , 1987	Derived	Foster&Chrostowski , 1987	$K = Ds + \exp(-Ra \times Dt)/Ra - (\exp(Ra) \times (Ds-Dt))/Ra$
	ED	Exposure Duration	years	24	U.S. EPA, May 1993	7	U.S. EPA, May 1993	
	BW	Body Weight	kg	70	U.S. EPA, May 1993	70	U.S. EPA, May 1993	
	Ra	Air Exchange Rate	min <sup>-1</sup>	0.0167	Foster&Chrostowski , 1987	0.0167	Foster&Chrostowski , 1987	
	Ds	Shower Duration	min	15	U.S. EPA, September 2001	10	U.S. EPA, September 2001	
	Dt	Total Time in Bathroom	min	20	Professional judgement	15	Professional judgement	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	8,760	U.S. EPA, December 1989	2,555	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure  
 CTE = Central Tendency Exposure

SITE 22 - TABLE 13  
VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF FUTURE CHILD RESIDENTS TO VAPORS FROM GROUNDWATER WHILE SHOWERING  
SITE 22 - BUILDING 105  
NTC, GREAT LAKES, ILLINOIS

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Groundwater  
Exposure Point: Tap Water  
Receptor Population: Resident  
Receptor Age: Child (0 to 6 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	S	Volatile Chemical Generation Rate	ug/m <sup>3</sup> -min shower	Derived	Foster&Chrostowski , 1987	Derived	Foster&Chrostowski , 1987	Chronic Daily Intake (CDI) (mg/kg-day)= $\frac{S \times IR_{sh} \times K \times EF \times ED}{BW \times AT \times Ra \times CF}$ $K = Ds + \exp(-Ra \times Dt)/Ra - [\exp(Ra) \times (Ds-Dt)]/Ra$
	IRsh	Inhalation Rate of Volatiles in Shower	L/min	10	U.S. EPA, December 1989	10	U.S. EPA, December 1989	
	EF	Exposure Frequency	days/year	350	U.S. EPA, May 1993	234	U.S. EPA, May 1993	
	K	Mass Transfer Coefficient	min	Derived	Foster&Chrostowski , 1987	Derived	Foster&Chrostowski , 1987	
	ED	Exposure Duration	years	6	U.S. EPA, May 1993	2	U.S. EPA, May 1993	
	BW	Body Weight	kg	15	U.S. EPA, May 1993	15	U.S. EPA, May 1993	
	Ra	Air Exchange Rate	min <sup>-1</sup>	0.0167	Foster&Chrostowski , 1987	0.0167	Foster&Chrostowski , 1987	
	Ds	Shower Duration	min	15	U.S. EPA, September 2001	10	U.S. EPA, September 2001	
	Dt	Total Time in Bathroom	min	20	Professional Judgement	15	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	2,190	U.S. EPA, December 1989	730	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure

CTE = Central Tendency Exposure

SITE 22 - TABLE 14

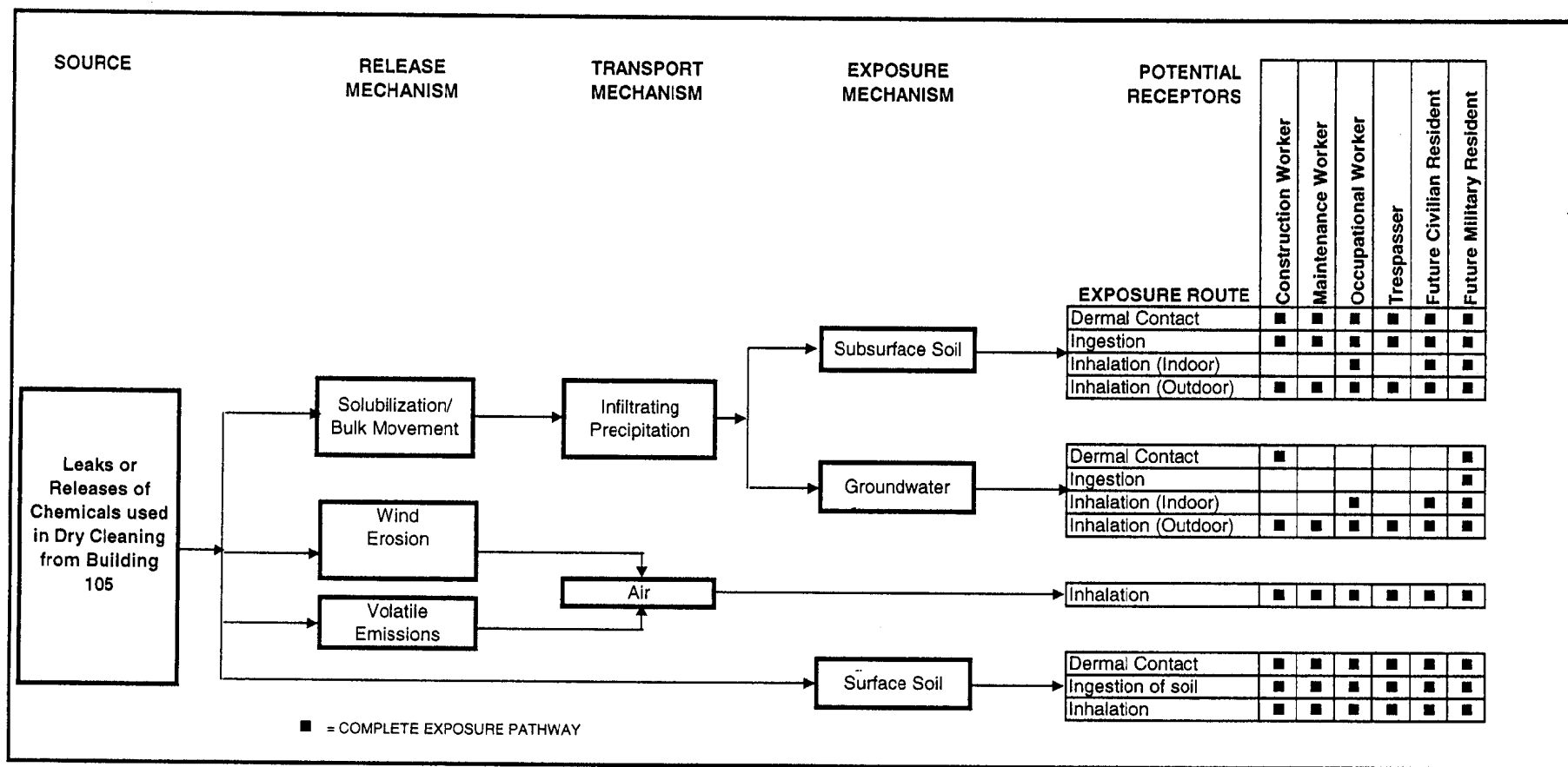
VALUES USED FOR DAILY INTAKE CALCULATIONS  
EXPOSURE OF CONSTRUCTION WORKERS TO AIR IN A TRENCH  
SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY  
NTC, GREAT LAKES, ILLINOIS

Scenario Timeframe: Future  
Medium: Groundwater  
Exposure Medium: Air  
Exposure Point: Trench (<15 feet deep)  
Receptor Population: Construction Worker  
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CTE Value	CTE Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Cair	Chemical Concentration in Air	mg/m <sup>3</sup>	Derived	VDEQ, August 2002	Derived	VDEQ, August 2002	Chronic Daily Intake (CDI) (mg/kg-day)= $C_{air} \times I R_a \times E T \times E F \times E D$ BW x AT
	IRa	Inhalation Rate of Volatiles	m <sup>3</sup> /hr	2.5	U.S. EPA, December 2002	2.5	U.S. EPA, December 2002	
	EF	Exposure Frequency	days/year	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	150	Professional Judgement. Ground assumed to be frozen 22 weeks/yr.	
	ED	Exposure Duration	year	1	Professional judgement	1	Professional judgement	
	ET	Exposure Time	hr/day	4	Professional judgement	2	Professional judgement	
	BW	Body Weight	kg	70	U.S. EPA, December 1989	70	U.S. EPA, December 1989	
	AT-C	Averaging Time (Cancer)	days	25,550	U.S. EPA, December 1989	25,550	U.S. EPA, December 1989	
	AT-N	Averaging Time (Noncancer)	days	210	U.S. EPA, December 1989	210	U.S. EPA, December 1989	

RME = Reasonable Maximum Exposure  
CTE = Central Tendency Exposure

**FIGURE 1**  
**HUMAN HEALTH CONCEPTUAL SITE MODEL**  
**SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**  
**NTC GREAT LAKES, ILLINOIS**



Blank space indicates incomplete exposure pathway or relatively insignificant, or not applicable potential exposure.

**APPENDIX V**

**SUPPLEMENTAL FIELD SAMPLING PLAN AND  
STANDARD OPERATING PROCEDURES – SITE 22**



**Supplemental Field Sampling Plan  
for  
Remedial Investigation &  
Risk Assessment  
at  
Site 22 – Building 105 Old Dry Cleaning  
Facility**

**Naval Training Center  
Great Lakes**  
Great Lakes, Illinois



**Southern Division  
Naval Facilities Engineering Command**

**Contract Number N62467-94-D-0888**

**Contract Task Order 0154/290**

June 2003

## TABLE OF CONTENTS

<b><u>SECTION</u></b>	<b><u>PAGE NO.</u></b>
<b>1.0 INTRODUCTION.....</b>	<b>IX-V-1</b>
1.1 INTRODUCTION.....	IX-V-1
<b>2.0 FIELD OPERATIONS .....</b>	<b>IX-V-2</b>
2.1.2 Site Restoration.....	IX-V-2
2.3.3 Monitoring Well Protectin .....	IX-V-2
2.4.1 Groundwater Sampling .....	IX-V-2
2.9 FIELD MEASUREMENTS.....	IX-V-2
<b>3.0 SITE-SPECIFIC FIELD SAMPLING PLANS.....</b>	<b>IX-V-3</b>
3.3 SITE 22 - BUILDING 105 FORMER DRY CLEANERS .....	IX-V-3

### **APPENDICES**

<b>A</b>	<b>FIELD FORMS</b>
<b>B</b>	<b>STANDARD OPERATING PROCEDURES</b>
	CTO 290-1 Natural Attenuation Parameter Collection

## 1.0 INTRODUCTION

### 1.1 INTRODUCTION

This Supplemental Field Sampling Plan (FSP) is an addendum to the existing FSP (Appendix V) and existing Quality Assurance Project Plan (QAPP) (TtNUS, 2001) for Naval Training Center (NTC) Great Lakes and describes the sampling and analysis procedures to be used for Site 22 - Building 105 Old Dry Cleaning Facility during Remedial Investigation/Risk Assessment activities. The investigation at Site 22 will be similar to the investigation at Site 7. Changes to the existing FSP and QAPP are noted in the text below. Tetra Tech NUS, Inc. (TtNUS) will conduct these activities under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Contract Number N62467-94-D-0888, in accordance with the Statement of Work for Contract Task Order (CTO) 290 at the NTC Great Lakes and the Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (U.S. EPA, 1988).

The field investigation at Site 22, NTC Great Lakes will consist of the tasks below. The majority of these tasks are described in the QAPP and FSP (TtNUS, 2001). The following section describes those activities that will be conducted that are not discussed in the QAPP and FSP (TtNUS, 2001).

- Mobilization/demobilization
- Field equipment maintenance
- Drilling
  - Installation of soil borings
  - Installation of permanent monitoring wells
- Soil sampling
  - Surface soil sampling
  - Subsurface soil sampling
- Groundwater sampling
  - Monitoring wells
- Equipment decontamination
- Aquifer testing
- Groundwater level measurements
- Investigation-derived waste (IDW) handling and disposal
- Site restoration
- Land surveying of sample locations

## **2.0 FIELD OPERATIONS**

### **2.1.2 Site Restoration**

Site restoration will also include replacing asphalt and the subsurface high density polyethylene (HDPE) liner at soil boring and monitoring well locations.

### **2.3.3 Monitoring Well Protection**

Surrounding the monitoring well a flush-mounted cover and vault will be installed in a 2 foot by 2 foot by 6 inch thick concrete pad. The flush-mounted concrete pads/casings will be completed level with existing grade.

### **2.4.1 Groundwater Sampling**

Groundwater samples will be collected from the 9 newly installed monitoring wells at Site 22 and submitted for fixed-based laboratory analyses. Sampling for natural attenuation parameters will also be performed at selected wells.

## **2.9 FIELD MEASUREMENTS**

Field measurements for the purposes of the natural attenuation analysis will be conducted using field test kits provided by HACH and CHEMetrics and will be recorded during field sampling operations. These field test kits include alkalinity, ferrous iron, manganese, carbon dioxide, dissolved oxygen, hydrogen sulfide, and sulfide.

SOP CTO 290-1 and the associated field sample logsheets provide additional details concerning the field natural attenuation analyses. Analyses using the field test kits will be conducted in accordance with the manufacturer's instructions.

### **3.0 SITE-SPECIFIC FIELD SAMPLING PLANS**

#### **3.3 SITE 22 - BUILDING 105 OLD DRY CLEANING FACILITY**

Background information about Site 22 - Building 105 Old Dry Cleaning Facility, including a site description and summary of previous investigations, can be found in Section A5 of the QAPP addendum. A detailed description of the proposed investigation for Site 22 is included in Section B2 of the QAPP addendum. The objectives of the proposed investigation are as follows:

- To determine human health and ecological risks for potential receptors exposed to site media under current and future land use scenarios.
- To delineate soil and groundwater contamination resulting from the site activities.

Figures B-4 and B-5 in the QAPP shows proposed sampling locations, and Tables B-23 through B-27 in the QAPP summarize the samples that will be collected at Site 22. Sample containers, preservation requirements, and holding times are provided in Tables B-10 and B-11.

## **APPENDIX A**

### **FIELD FORMS**



# FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page    of   

Project Site Name: NTC Great Lakes Site 22

Sample ID No.:                     

Project No.: N1474 CTO 290

Sample Location:                     

Sampled By:                     

Duplicate: ☐

Field Analyst:                     

Blank: ☐

Field Form Checked (initials):                     

## SAMPLING DATA:

Date:	Color	ORP (Eh)	S.C.	Temp.	Turbidity	DO	Sal.	pH
Time:	(Visual)	(+/- mv)	(mS/cm)	(°C)	(NTU)	(Meter, mg/l)	(%)	(SU)
Method:								

## SAMPLE COLLECTION/ANALYSIS INFORMATION:

### Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT      CHEMetrics (Range:          mg/L)

Analysis Time:                     

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
<input type="checkbox"/>	1-5 mg/L	200 ml	0.200 N	0.01
<input type="checkbox"/>	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier	Concentration
<u>        </u>	x 0.01	=
<u>        </u>	x 0.02	=

CHEMetrics:          mg/L

Notes:                                     

### Alkalinity:

Equipment: HACH Digital Titrator AL-DT      CHEMetrics (Range:          mg/L)

Analysis Time:                     

Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier	Concentration
<input type="checkbox"/>	10-40 mg/L	100 ml	0.1600 N	0.1	<u>        </u> & <u>        </u>	x 0.1	=
<input type="checkbox"/>	40-160 mg/L	25 ml	0.1600 N	0.4	<u>        </u> & <u>        </u>	x 0.4	=
<input type="checkbox"/>	100-400 mg/L	100 ml	1.600 N	1.0	<u>        </u> & <u>        </u>	x 1.0	=
<input type="checkbox"/>	200-800 mg/L	50 ml	1.600 N	2.0	<u>        </u> & <u>        </u>	x 2.0	=
<input type="checkbox"/>	500-2000 mg/L	20 ml	1.600 N	5.0	<u>        </u> & <u>        </u>	x 5.0	=
<input type="checkbox"/>	1000-4000 mg/L	10 ml	1.600 N	10.0	<u>        </u> & <u>        </u>	x 10.0	=

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:			

CHEMetrics:          mg/L

Notes:                                     

Standard Additions: ☐      Titrant Molarity:               Digits Required: 1st.:               2nd.:               3rd.:         

### Carbon Dioxide:

Equipment: HACH Digital Titrator CA-DT      CHEMetrics (Range:          mg/L)

Analysis Time:                     

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
<input type="checkbox"/>	10-50 mg/L	200 ml	0.3636 N	0.1
<input type="checkbox"/>	20-100 mg/L	100 ml	0.3636 N	0.2
<input type="checkbox"/>	100-400 mg/L	200 ml	3.636 N	1.0
<input type="checkbox"/>	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count	Multiplier	Concentration
<u>        </u>	x 0.1	=
<u>        </u>	x 0.2	=
<u>        </u>	x 1.0	=
<u>        </u>	x 2.0	=

CHEMetrics:          mg/L

Notes:                                     

Standard Additions: ☐      Titrant Molarity:               Digits Required: 1st.:               2nd.:               3rd.:



# FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page    of   

Project Site Name: NTC Great Lakes Site 22

Sample ID No.:                     

Project No.: N1474 CTO 290

Sample Location:                     

Sampled By:                     

Duplicate: ☐

Field Analyst:                     

Blank: ☐

Field Form Checked (initials):                     

## SAMPLE COLLECTION/ANALYSIS INFORMATION:

### Sulfide ( $S^{2-}$ ):

Equipment: DR-700

DR-8   

HS-C Color Chart

HS-WR Color Wheel

Analysis Time:                     

Program/Module: 610nm

93

Other:                     

Concentration:                      mg/L

Filtered: ☐

Notes:                     

### Sulfate ( $SO_4^{2-}$ ):

Equipment: DR-700

DR-8   

Other:                     

Analysis Time:                     

Program/Module:                     

91

Concentration:                      mg/L

Filtered: ☐

Standard Solution: ☐

Results:                     

Standard Additions: ☐

Digits Required: 0.1ml:            0.2ml:            0.3ml:           

Notes:                     

### Nitrite ( $NO_2^-$ -N):

Analysis Time:                     

Equipment: DR-700

DR-8   

Other:                     

Filtered: ☐

Program/Module:                     

60

Concentration:                      mg/L

Reagent Blank Correction: ☐

Standard Solution: ☐ Results: ☐

Notes:                     

### Nitrate ( $NO_3^-$ -N):

Analysis Time:                     

Equipment: DR-700

DR-8   

Other:                     

Filtered: ☐

Program/Module:                     

55

Concentration:                      mg/L

Nitrite Interference Treatment: ☐

Standard Solution: ☐

Results:                     

Reagent Blank Correction: ☐

Standard Additions: ☐

Digits Required: 0.1ml:            0.2ml:            0.3ml:           

Notes:





# FIELD ANALYTICAL LOG SHEET GEOCHEMICAL PARAMETERS

Tetra Tech NUS, Inc.

Page \_\_\_ of \_\_\_

Project Site Name: NTC Great Lakes Site 22

Sample ID No.: \_\_\_\_\_

Project No.: N1474 CTO 290

Sample Location: \_\_\_\_\_

Sampled By: \_\_\_\_\_

Duplicate: ☐

Field Analyst: \_\_\_\_\_

Blank: ☐

Field Form Checked (initials): \_\_\_\_\_

## SAMPLE COLLECTION/ANALYSIS INFORMATION:

### Manganese ( $Mn^{2+}$ ):

Equipment: DR-700 DR-8 \_\_ HACH MN-5 Other: \_\_\_\_\_ Analysis Time: \_\_\_\_\_

Program/Module: 525nm 41

Concentration: \_\_\_\_\_ mg/L

Filtered: ☐

Digestion: ☐

Standard Solution: ☐

Results: \_\_\_\_\_

Reagent Blank Correction: ☐

Standard Additions: ☐

Digits Required: 0.1ml: \_\_\_\_\_ 0.2ml: \_\_\_\_\_ 0.3ml: \_\_\_\_\_

Notes: \_\_\_\_\_

### Ferrous Iron ( $Fe^{2+}$ ):

Equipment: DR-700 DR-8 \_\_ IR-18C Color Wheel Other: \_\_\_\_\_ Analysis Time: \_\_\_\_\_

Program/Module: 500nm 33

Concentration: \_\_\_\_\_ mg/L

Filtered: ☐

Notes: \_\_\_\_\_

Analysis Time: \_\_\_\_\_

Equipment: DR-700 DR-8 \_\_ Other: \_\_\_\_\_

Filtered: ☐

Program/Module: \_\_\_\_\_

Concentration: \_\_\_\_\_ mg/L

Notes: \_\_\_\_\_

Analysis Time: \_\_\_\_\_

Equipment: DR-700 DR-8 \_\_ Other: \_\_\_\_\_

Filtered: ☐

Program/Module: \_\_\_\_\_

Concentration: \_\_\_\_\_ mg/L

Notes: \_\_\_\_\_

## **APPENDIX B**

### **STANDARD OPERATING PROCEDURES**

## STANDARD OPERATING PROCEDURE

### SOP CTO 290-1

## NATURAL ATTENUATION PARAMETER COLLECTION

### 1.0 PURPOSE

The purpose of this document is to provide general reference information regarding natural attenuation parameter and methodology selection, sample collection, and a general understanding of the sample results.

### 2.0 SCOPE

This document provides information on selection of appropriate groundwater natural attenuation parameters, selection of sampling methods for these parameters, techniques for onsite field analysis of select parameters, and some basic understanding of the field sample results. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling practices and techniques. To a limited extent, it shall also facilitate the understanding and interpretation of the sampling results. It addresses field procedures for collection of data at sites with organic groundwater contaminants (e.g., chlorinated and petroleum hydrocarbons) to the extent practical. The focus of this document is on natural attenuation, not enhanced bioremediation.

The techniques described shall be followed whenever applicable, noting that site-specific conditions, project-specific objectives, local, state, and federal guidelines may be used as a basis for modification of the procedures noted herein. The intent of this document is to supplement the local, state, and federal guidance documents and manufacturer's analytical methods referenced in Section 6.0. It is not intended for this document to supersede this guidance or information. Please note that natural attenuation is a relatively dynamic science with ongoing research in the science and engineering community. It is important that data collectors and interpreters use the most recent regulatory guidance, which may be updated on a periodic basis from that noted in Section 6.

### 3.0 GLOSSARY

*Aerobe*: Bacteria that use oxygen as an electron acceptor.

*Anaerobe*: Organisms that can use electron acceptors other than molecular oxygen to support their metabolism.

*Anoxic groundwater*: Groundwater that contains oxygen in concentrations less than about 0.5 mg/L. This term is synonymous with the term anaerobic.

*Anthropogenic*: Man-made.

*Cometabolism*: The process in which a compound is fortuitously degraded by an enzyme or cofactor produced during microbial metabolism of another compound.

*Daughter product*: A compound that results directly from the biotic or abiotic degradation of another. For example, *cis*-1,2-dichloroethene (*cis*-1,2-DCE) is a common daughter product of trichloroethene (TCE).

*Diffusion*: The process whereby molecules move from a region of higher concentration to a region of lower concentration as a result of Brownian motion.

*Dispersion*: The tendency for a solute to spread from the path that it would be expected to follow under advective transport.

*Electron acceptor:* A compound capable of accepting electrons during oxidation-reduction reactions. Microorganisms obtain energy by transferring electrons from an electron donor such as an organic compound (or sometimes a reduced inorganic compound such as sulfide) to an electron acceptor. Electron acceptors are compounds that are relatively oxidized and include oxygen, nitrate, iron(III), manganese(IV), sulfate, carbon dioxide, or in some cases chlorinated aliphatic hydrocarbons such as tetrachloroethene (PCE), TCE, DCE and vinyl chloride (VC).

*Electron donor:* A compound capable of supplying (giving up) electrons during oxidation-reduction reactions. Microorganisms obtain energy by transferring electrons from an electron donor such as an organic compound (or sometimes a reduced inorganic compound such as sulfide) to an electron acceptor. Electron donors are compounds that are relatively reduced and include fuel hydrocarbons and native organic carbon.

*Metabolic byproduct:* A product of the reaction between an electron donor and an electron acceptor. Metabolic byproducts include volatile fatty acids, daughter products of chlorinated aliphatic hydrocarbons, methane, and chloride.

*Oxic groundwater:* Groundwater that contains oxygen in concentrations greater than about 0.5 mg/L.

*Oxidation/reduction reaction:* A chemical or biological reaction wherein an electron is transferred from an electron donor (donor is oxidized) to an electron acceptor (acceptor is reduced).

*Predominant terminal electron-accepting process:* The electron-accepting process (oxygen reduction, nitrate reduction, iron(III) reduction, etc.) that sequesters the majority of the electron flow in a given system.

*Reductive dechlorination:* Reduction of a chlorine-containing organic compound via the replacement of chlorine with hydrogen.

*Respiration:* The process of coupling the oxidation of organic compounds with the reduction of inorganic compounds such as oxygen, nitrate, iron(III), manganese(IV), and sulfate.

*Seepage velocity:* The average velocity of groundwater in a porous medium.

*Substrate:* A compound used by microorganisms to obtain energy for growth. The term can refer to either an electron acceptor or an electron donor.

#### **4.0 RESPONSIBILITIES**

Project Manager (PM) / Task Order Manager (TOM) - Responsible for ensuring that field activities are conducted in accordance with this standard operating procedure (SOP).

Project Hydrogeologist or Geochemist - Responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), and equipment to be used, and providing detailed input in this regard to the project plan documents. The project hydrogeologist or geochemist is also responsible for properly briefing and overseeing the performance of the site sampling personnel.

Site Manager (SM) / Field Operations Leader (FOL) - Responsible for the onsite verification that the field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Project Geologist - is primarily responsible for the proper acquisition of the groundwater samples. He/she is also responsible for the actual analyses of onsite water quality samples, as well as instrument calibration, care, and maintenance. When appropriate, such responsibilities may be performed by other qualified personnel (e.g., field sampling technicians or site personnel).

## **5.0 PROCEDURES**

### **5.1 General**

Natural attenuation includes physical, chemical, and biochemical processes affecting the concentrations of dissolved contaminants in groundwater. These processes may include advection, dispersion, volatilization, dilution, sorption to aquifer solids, and/or precipitation or mineralization of compounds. Of greatest importance are those processes that lead to a reduction in contaminant mass (by degrading or destroying contaminants) such as biodegradation. These biochemical processes remove organic contaminants from the aquifer by destruction. Depending on the type of contaminant, particularly the organic contaminant (e.g., petroleum hydrocarbons or chlorinated organic solvents), the biochemical environment in the aquifer will vary. The biochemical environment within the aquifer influences and is influenced by the activities of aquifer microbiota. Specific types of microbiota, working singly or in complex consortia, may use organic contaminants as part of their normal cell functions. Natural attenuation monitoring is designed to measure indicators of the biochemical environment within the aquifer and, with direct and indirect lines of evidence and associated chemical concentration data, evaluate the likely fate (i.e., transformation, destruction, dilution, attenuation, etc.) of organic contaminants.

### **5.2 Planning for Natural Attenuation Sampling**

The first step in preparing a natural attenuation investigation is to develop a site-specific conceptual model. The first step in development of this model is the analysis and review of available site-specific characterization data. The development and refinement of this model should be supplemented with additional data as needed. The data should include but is not limited to:

- Geologic and hydrogeologic information in three dimensions
- Nature, extent, and magnitude of contamination
- Location and presence of potential receptors to contamination

#### **Lines of Evidence**

Several lines of evidence are used to determine whether natural attenuation is working. The most compelling, primary evidence is decreasing groundwater contaminant concentrations over time. Decreasing concentration trends can be demonstrated in several ways including:

- Isoconcentration maps of the dissolved plume over time wherein the extent of the plume is either stable or decreasing.
- Time series plots of contaminant concentrations within a well illustrating a clear downward trend.
- Contaminant concentration profiles in a series of monitoring wells along a groundwater flow path illustrating decreasing concentrations beyond that attributable to dilution and dispersion.

Secondary, or supporting, lines of evidence include:

- Analytical data showing production and subsequent destruction of primary contaminant breakdown products.

- Geochemical data indicating that the biochemical environment is favorable for the appropriate microbiota.
- Geochemical data that indicate the aquifer microbiota are active.

### **Monitoring Well Location and Sampling Frequency**

The number and locations of wells required to monitor natural attenuation will depend on the physical setting at each location. One possible array of monitoring wells is illustrated in Attachment A. In this scenario, one well is used to monitor conditions upgradient of the source, one well is located in the source area, and several wells are used to define and monitor the downgradient and lateral extent of the dissolved plume. At a minimum, there should be at least one upgradient well (ideally with no contamination present), one well in the source area, one well downgradient from the source area in the dissolved plume, and one downgradient well where contaminant concentrations are below regulatory criteria. Note that the number and locations of monitoring wells will vary depending on the site complexity and site objectives.

Sampling frequency will be dictated by the ultimate use of the data and site-specific characteristics. Contaminant concentrations may be used to define statistically meaningful trends in contaminant concentrations. The sampling frequency may be defined by the hydrogeologic and/or geochemical conditions as well as the proposed statistical method for data analysis. For example, groundwater flow and contaminant characteristics (e.g., seepage velocity and contaminant loading) may dictate the sample frequency. Regardless of the factors, sampling frequency and duration will need to establish the range of natural chemical variability within the aquifer. After a sufficient amount of data has been collected and the geochemical conditions are understood, the frequency of sampling may be reduced. See Section 5.4 for additional information on sample collection and frequency.

### **5.3 Selection of Natural Attenuation Parameters**

Natural attenuation via biodegradation depends on the nature of the organic contaminants and the oxidation-reduction (redox) environment within the aquifer. Simply stated, if the contaminants are fuels, biodegradation will be most effective if the redox conditions are aerobic or oxidizing. If the contaminants are chlorinated solvents, the biodegradation will be most effective (in the source and near source areas) if redox conditions in the aquifer are anaerobic or reducing.

Several parameters are needed to evaluate whether natural attenuation is taking place and, if so, the rate at which it may be occurring. The primary parameter providing direct evidence of natural attenuation is the aqueous concentrations of parent and daughter volatile organic compounds. More specifically, a decrease in percent products, an increase in daughter products, evidence that the plume is stable or shrinking in size, and overall decline in contaminant concentrations is direct evidence of natural attenuation. Natural attenuation or geochemical parameters that provide information about the redox conditions in the aquifer include:

- Dissolved oxygen
- Nitrate/nitrite
- Dissolved manganese
- Iron
- Sulfate/sulfide
- Methane
- Oxidation-reduction potential (ORP)

Secondary parameters that indicate biological activity in the aquifer and thereby support the natural attenuation evaluation include:

- Dissolved hydrogen
- Alkalinity
- Dissolved carbon dioxide

The concentrations of natural attenuation parameters are used to define the aquifer redox conditions. It is important to record and document the presence or absence (i.e., measurable or not measurable concentration) of certain natural attenuation parameters. The presence or absence of a certain substance may be sufficient to indicate the redox condition within the aquifer. By reference to Attachment B, which illustrates the typical sequence of biologically mediated redox reactions in natural systems, it is apparent that, for example, sulfate reduction (producing dissolved sulfide in groundwater) does not operate in an aerobic environment. Therefore, measurable sulfide should not be present if there is also dissolved oxygen at concentrations indicating an aerobic environment. Attachment B also illustrates the redox potential (measured in millivolts) associated with the redox reactions. ORP readings, also in millivolts, measured during well purging, may be compared with the range of values in Attachment B but with caution. Redox potentials measured with a platinum electrode in natural water samples may be misleading, especially when biologically mediated reactions are important, because many of the critical reactions in Attachment B do not generate a response in the electrode. Dissolved hydrogen concentration ranges associated with important redox reactions are also indicated in Attachment B. Because dissolved hydrogen is actually used by microbiota during redox reactions, its concentration may provide an additional indicator of the overall redox condition in the aquifer.

Attachments C and D tabulate the natural attenuation parameters for chlorinated volatile organic compound and petroleum hydrocarbon plumes, respectively. The parameters listed in these tables are organized in order of importance. Parameters selected for analysis shall be determined based on site conditions, project-specific plans, and/or other criteria established for the project. Based on these criteria, it is possible that all of the parameters may be selected.

#### **5.4 Selection of Natural Attenuation Analytical Methods and Procedures**

There are many analytical methods available to measure concentrations of the natural attenuation parameters discussed in the previous sections. Attachment E summarizes the sample methodologies, sampling equipment needed, sample volume, container, preservation, and holding time requirements. This table also summarizes the detection limits and the detection ranges for each method. A number of factors should be considered when selecting the appropriate sample analytical methodology including the required parameters, appropriate detection ranges for each compound, cost, and ease of use in the field. For example, when determining the correct methodology for measuring concentrations of total sulfide, the metabolic byproduct of sulfate reducing conditions, it is important to analyze for each of the forms of sulfide ( $\text{H}_2\text{S}$ ,  $\text{S}^{2-}$ , and  $\text{HS}^-$ ). Also, when the detection limit of the selected method is exceeded, another method may be considered, or the sampler may be able to dilute the sample (per manufacturer's instructions) to quantify it within the detected range. In terms of cost, some parameters are very time consuming when performed in the field. Without sacrificing sample integrity it may be more appropriate to select a methodology performed in a fixed-base laboratory. Finally, in terms of ease of use, certain field methods are generally easier compared to other methods. Using simpler methods may result in better quality sample results and increased sample repeatability without sacrificing sample integrity. For example, in some cases CHEMetrics Titret® Titration Ampule kits may be a good alternative to other hand digital titration methods.

The sample technicians should be aware that based on geochemical conditions recorded in the field, certain geochemical parameters may not have positive detections. For example, if dissolved oxygen

concentrations indicate aerobic conditions then it is unlikely that dissolved hydrogen is present (see Section 5.10 for additional information). Another example is alkalinity. If the pH of the groundwater sample is less than 4.5, then it is unlikely that alkalinity will be measurable. Despite the potential for non-detect results, in cases such as those described above, the parameters should be collected in the field based upon project plans. The value in collecting the parameters in the future shall be determined by the project hydrogeologist and/or geochemist in accordance with the projects planning documents data quality objectives (DQO) and the items discussed in Section 5.2.

## **5.5 Procedures for Sample Collection**

Groundwater sample collection for natural attenuation sampling should be performed using low flow purging and sampling techniques. Low flow purging and sampling procedures should be used to ensure the collection of a sample that is "representative" of the water present in the aquifer formation. Minimizing stress on the aquifer formation during low flow purging and sample collection ensures that there are minimal alternations to the water chemistry of the sample. The criteria used in the purging process should include minimization of drawdown in the well, stabilization of applicable indicator parameters, and evacuation of a sufficient amount of purge volume in accordance project plans and/or applicable regulatory guidance.

Groundwater purging and sampling for natural attenuation should be performed using submersible pumps (e.g., bladder pumps). However, in accordance with project plans and applicable regulatory guidance, peristaltic pumps may also be used for this purpose. Limitations of and factors associated with using these devices should be considered. As a result of difficulties in collecting "representative" groundwater samples, bailers should not be used for the collection of natural attenuation samples.

It is critical that disturbance and aeration of samples monitored and collected at the well head are minimized. As a result, a flow-through sampling cell and a direct reading meter shall be used for the measurement of well stabilization indicator parameters (e.g., pH, conductivity, temperature, dissolved oxygen, turbidity, and ORP) at the well head. The pump effluent tubing should be placed at the bottom of the flow-through cell allowing effluent water from the cell to discharge at the top of the meter (above the detector probes) to minimize the agitation of water in the cell.

Documentation of the purging process shall be recorded during and at the completion of purging as discussed in Section 5.8. Immediately following the purging process and before sampling, applicable indicator parameters must be measured and recorded on the appropriate sample log sheets as discussed in Section 5.8.

After the purging requirements have been met, groundwater sampling and natural attenuation data collection can begin. Monitoring wells will be sampled using the same pump and tubing used during well purging.

## **5.6 Procedures for Field Sample Analysis**

Each of the field and fixed-base laboratory sample parameters requires different sampling procedures and holding times. Attachment E presents parameter-specific requirements for sampling, analysis, and storage of the parameters and methods sampled as part of natural attenuation analysis.

Due to parameter procedure and holding times, it is important to consider the sequence of sample collection and analysis. Generally speaking, with the exception of volatile organic compounds, field parameters shall be analyzed first followed by fixed-base laboratory sample collection. Samples will be collected in a sequence and manner that minimizes volatilization, oxidation, and/or chemical transformation of compounds. As a result, the following sample and analysis order should be followed:



- |  |                                   |
|--|-----------------------------------|
| 1. Volatile organic compounds                      | 8. Nitrate / Nitrite              |
| 2. Dissolved oxygen                                | 9. Dissolved manganese            |
| 3. Alkalinity                                      | 10. Semivolatileorganic compounds |
| 4. Dissolved carbon dioxide                        | 11. Other dissolved metals        |
| 5. Dissolved ferrous iron                          | 12. Total metals                  |
| 6. Dissolved sulfide (hydrogen sulfide, sulfide)   | 13. Other constituents            |
| 7. Dissolved hydrogen, methane, ethene, and ethane |                                   |

Field-analyzed parameters should be collected and immediately analyzed directly from the pump effluent per the requirements on Attachment E and manufacturer's recommendations. Care should be taken to minimize any unnecessary disturbance, aeration, or agitation of the sample prior to analysis. It is not acceptable to collect and store samples that are to be analyzed immediately at the well head in a temporary holding container (e.g., open topped pitcher) to be analyzed at a later time.

The manufacturer's procedure manual for each of the field-based analyses shall be maintained in the field during the entire sampling program. The procedures give a detailed explanation of how to perform each particular method and include information on sampling, storage, accuracy checks, interferences, reagents, and apparatus needed to perform each analysis.

#### 5.7 Procedures for Quality Assurance and Quality Control Field Sample Analysis

Accuracy and precision checks shall be performed to check the performance of the reagents, apparatus, and field analytical procedures per the manufacturer's recommendations. The accuracy checks should include the use of standard solutions (i.e., standard addition), as appropriate. The manufacturer's field test kit manual provides details on how to perform each of the accuracy checks for each parameter where applicable. Refer to Section 6.0 for manufacturer contact information.

Precision checks must include the performance of duplicate analysis. When using a colorimeter, precision checks may also include reagent blank corrections and standard curve adjustments as recommended by the manufacturer. Field duplicate results shall be performed and evaluated for relative percent difference (RPD) at a rate of 1 per 10 samples or as determined by the project plans. The RPD can be calculated as follows:

$$RPD = \left| \frac{\text{First result} - \text{Second result}}{\text{Mean arithmetic (average) of first and second result}} \right| \times 100$$

If the RPD exceeds 50 percent, it is required that the test be performed again to verify the result. The duplicate results shall be documented in the 'Notes' section for that specific parameter on the appropriate sample logsheet (see Section 5.8).

If a colorimeter (e.g., HACH DR-890 or equivalent) is used for parameter analysis, an instrument performance verification test using absorbance standards may also be performed to ensure the meter is providing accurate measurements.

The following table lists examples of the types and frequencies of accuracy checks required for each parameter. Refer to the manufacturer's instructions for information regarding other analyses.

Parameter	Method	Standard Solution	Field Duplicate	Reagent Blank Correction
Alkalinity	CHEMetrics K-9810, -15, -20	None	1 per 10	None
Carbon dioxide	CHEMetrics K-1910, -20, -25	None	1 per 10	None
Dissolved oxygen	CHEMetrics K-7501, -12	None	1 per 10	None
Ferrous iron	HACH DR-890	None	1 per 10	None
Nitrite	HACH DR-890	1 per round	1 per 10	1 per lot
Nitrate	HACH DR-890	1 per round	1 per 10	1 per lot
Sulfide	HACH DR-890	None	1 per 10	None
Hydrogen sulfide	HACH HS-C	None	1 per 10	None

Prior to analysis, the expiration dates of reagents shall be checked. If the reagents have exceeded their expiration date or shelf life, the reagents shall be replaced. If deviations from the applicable analytical procedure are identified, the deviations shall be corrected and the associated samples re-analyzed. If problems are identified with the reagents, apparatus, or procedures, data interferences may be present. Interferences may also be due to other factors (e.g., pH, presence or concentration of other ions, turbidity, temperature, etc.) that may interfere with the sample result. The manufacturer's procedures (e.g., Hach, 1999) should be reviewed prior to analysis to avoid or minimize such interferences. Associated problems or suspected interferences shall be documented in the 'Notes' section of the sample logsheet. Often, interferences cannot be avoided. In these cases, the sampler should be aware of these potential interferences and document them properly.

#### 5.8 Documentation Procedures for Field Sample Analysis

Field results shall be properly documented in the field. The sample log sheet titled "Field Analytical Log Sheet, Geochemical Parameters" shall be prepared for each sample collected and analyzed in the field. Other field log sheets (e.g., low flow purge log sheet, groundwater sample logsheet, etc.) shall also be completed.

Specific information shall also be recorded in the project logbook. This information shall include, but is not limited to, the test kit name and model number, lot number and expiration date of the test kit and reagents used, serial number of the instrument (e.g., colorimeter) used for the analysis, and results of the quality assurance and quality control field sample analysis. Because environmental conditions and changes in those conditions may affect the field analytical results, it is important to document the site conditions (weather, temperature, etc.) at the time of sampling in the logbook.

#### 5.9 Waste Handling and Disposal

Several of the test kits listed in Attachment E require the use of chemicals and materials that must be properly handled and disposed of in a proper and responsible manner. Refer to the handling and disposal practices and the specific manufacturer's guidance listed in Section 6.0 for more detailed and complete information. Handling and disposal of these items should be conducted in accordance with local, state, and federal guidelines.

## 5.10 Understanding Field Sample Analytical Results

Natural attenuation data interpretation is complicated by the complex inter-relationships of various parameters. The complexity reflects the myriad of biochemical processes. Real-time evaluation of field analytical data can be misleading because a full interpretation often requires combining the field analytical results with fixed-base laboratory results. Regardless, some simple observations and data interpretations in the field may provide insights about the monitoring system or early warnings about sample collection and handling problems.

Data collected from the designated upgradient monitoring well is the baseline from which other interpretations are made. Field analytical data will indicate that the upgradient environment is either oxidizing or reducing. The redox condition within the upgradient area of the aquifer may be natural or impacted by other contaminant source areas (see Section 5.2 for upgradient well selection). Regardless, the redox condition of the upgradient groundwater will influence the source area. Changes in field analytical results from the upgradient well to the source area well will be reflected in samples from monitoring wells further downgradient.

The general characteristics of the two redox environments are summarized in the following table.

<b>Aerobic/Oxidizing</b>	<b>Anaerobic/Reducing</b>
<ul style="list-style-type: none"> <li>• Measurable dissolved oxygen (&gt;1 to 2 ppm)</li> <li>• Measurable nitrate</li> <li>• No measurable dissolved manganese</li> <li>• No measurable dissolved ferrous iron</li> <li>• Measurable dissolved sulfate</li> <li>• No measurable dissolved sulfide</li> <li>• No measurable dissolved methane</li> <li>• No measurable dissolved hydrogen</li> </ul>	<ul style="list-style-type: none"> <li>• No measurable dissolved oxygen (&lt;1 ppm)</li> <li>• No measurable nitrate</li> <li>• Measurable dissolved manganese</li> <li>• Measurable dissolved ferrous iron</li> <li>• No measurable dissolved sulfate</li> <li>• Measurable dissolved sulfide</li> <li>• Measurable dissolved methane</li> <li>• Measurable dissolved hydrogen</li> </ul>

Transitional environments between these two extremes may have intermediate characteristics and are actually quite common. Because reactions are mediated by biological systems, equilibrium (the basis for the figure in Attachment B) conditions within the aquifer should not be expected. For example, sulfate reduction environments may occur in close proximity to methanogenic environments, and this natural attenuation data may be difficult to interpret. Carefully collected and analyzed field measurements and sample collections for fixed-base laboratory analyses are designed to characterize the aquifer environment along the continuum between strongly aerobic and strongly anaerobic. Because the land surface environment is generally more oxidizing than any groundwater environment, sample handling at the point of collection and analysis is extremely important in preserving the chemical integrity of the groundwater sample.

## 6.0 REFERENCES

American Society for Testing and Materials (ASTM), 1998. Standard Guide for Remediation of Ground Water by Natural Attenuation at Petroleum Release Sites, Designation: E1943-98, West Conshohocken, Pennsylvania.

Chemetrics, 2002, <http://www.chemetrics.com>.

Department of the Navy, 1998. Technical Guidelines for Evaluating Monitored Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Ground Water at Naval and Marine Corps Facilities, Department of the Navy, September. Prepared by T. H. Weidemeier and F. H. Chappelle.

USEPA (United States Environmental Protection Agency), 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128, Office of Research and Development, Washington, D.C.

Hach Company, 1999. DR-890 Colorimeter Procedures Manual, Product Number 48470-22, Loveland Colorado.

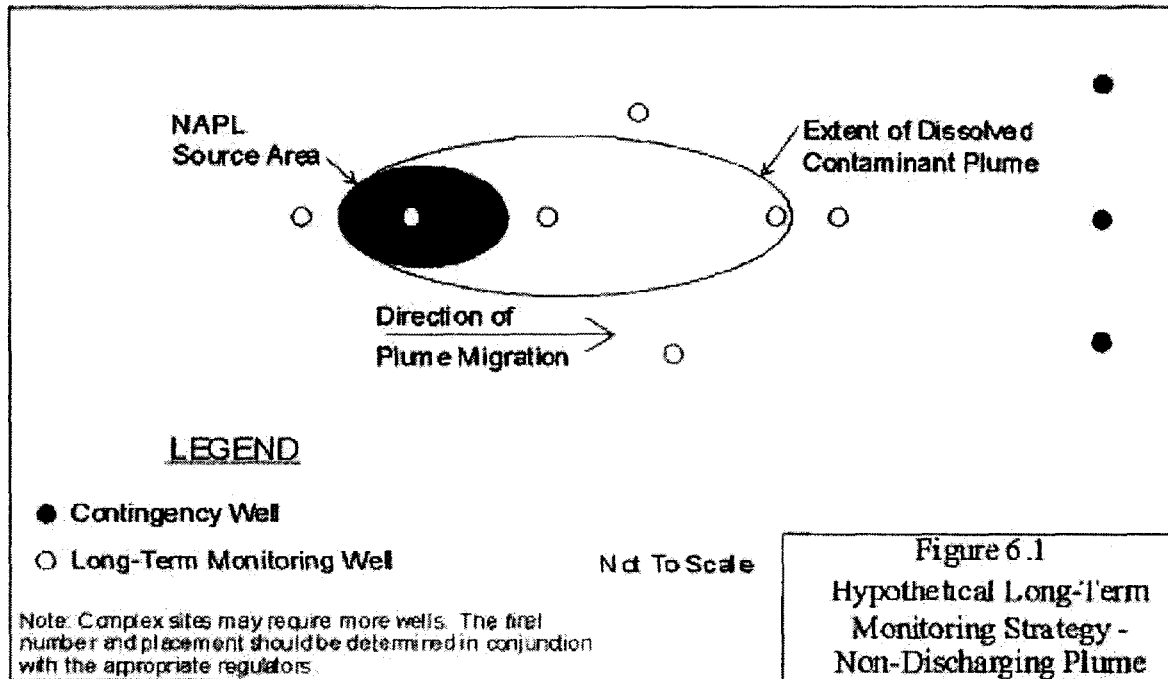
Hach Company, 1999. Digital Titrator (manual), Model Number 16900, Catalog Number 16900-08. Loveland, Colorado.

Hach Company, 2002, <http://www.hach.com/>.

USEPA, 1997. Draft EPA Region 4 Suggested Practices for Evaluation of a Site for Natural Attenuation (Biological Degradation) of Chlorinated Solvents; Version 3.0. November.

USEPA, 1999. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, USEPA OSWER Directive 9200.4-17P, April 21, 1999

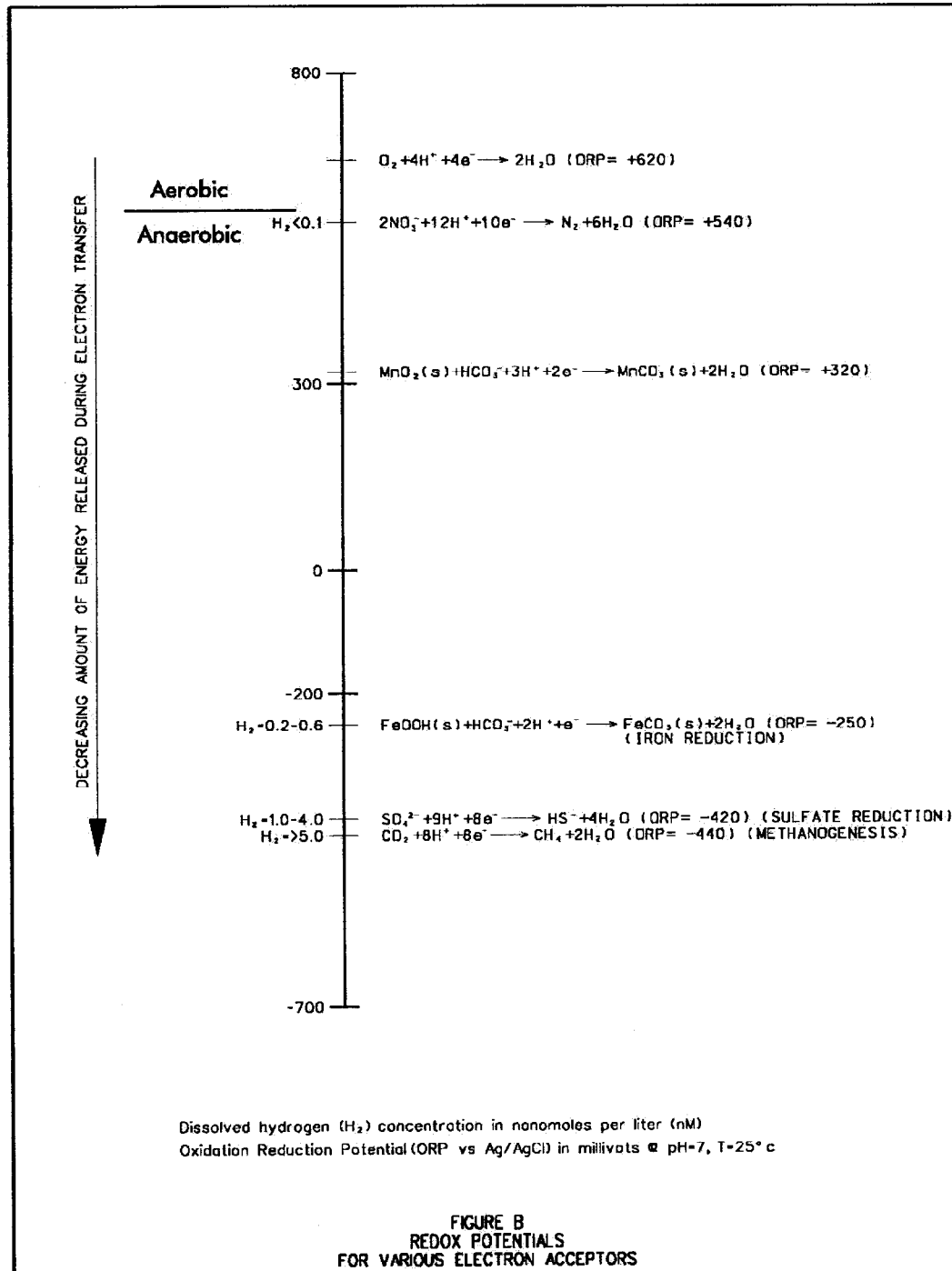
# **ATTACHMENT A** **HYPOTHETICAL LONG-TERM MONITORING STRATEGY**



Taken from: Department of the Navy, 1998, Technical Guidelines for Evaluating Monitored Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Ground Water at Naval and Marine Corps Facilities, Prepared by Todd Weidemeier and Francis Chappelle.

## ATTACHMENT B

### REDOX POTENTIALS FOR VARIOUS ELECTRON ACCEPTORS



k:\dgn\nevy\orlando\stiles\ed2-033.dgn 9-18-02

## ATTACHMENT C

### NATURAL ATTENUATION PARAMETERS FOR CHLORINATED VOLATILE ORGANIC COMPOUND PLUMES SCREENING PROCESS SUMMARY FOR REDUCTIVE (ANAEROBIC) DECHLORINATION

Potential Electron Donors	Electron Acceptors:	Reduced Species:	Related Dechlorination Pathway:
Native total organic carbon (TOC)	Dissolved Oxygen	⇒ Carbon Dioxide (CO <sub>2</sub> )	~ DCE → VC → CO <sub>2</sub>
Anthropogenic carbon (e.g., leachate)	Manganese (Mn <sup>4+</sup> )	⇒ Manganese (Mn <sup>2+</sup> )	~ DCE → VC
Fuel hydrocarbons (e.g., BTEX)	Nitrate (NO <sub>3</sub> )	⇒ Nitrite (NO <sub>2</sub> )	~ DCE → VC
Lightly chlorinated solvents (DCE/VC)	Ferric Iron (Fe <sup>3+</sup> )	⇒ Ferrous Iron (Fe <sup>2+</sup> )	~ DCE → VC → CO <sub>2</sub>
	Sulfate (SO <sub>4</sub> )	⇒ Sulfide (S <sup>2-</sup> , HS <sup>-</sup> , H <sub>2</sub> S)	~ TCE → DCE → VC → Ethene
	Carbon Dioxide (CO <sub>2</sub> )	⇒ Methane (CH <sub>4</sub> )	~ PCE → TCE → DCE → VC → Ethene

#### Geochemical Parameter List:

Parameter	Field or Lab	Rationale	Importance
Volatile organic compounds	L	Source products; daughter products; electron donors (e.g., benzene, toluene, ethylbenzene, and xylene; BTEX)	1
Dissolved oxygen	F	Primary electron acceptor (respiration); an/aerobic indicator	1
Nitrate (and nitrite), dissolved	F or L	Anaerobic electron acceptor (product of nitrate reduction)	1
Manganese, dissolved	F or L	Anaerobic electron acceptor	1
Ferrous Iron (Fe <sup>2+</sup> )	F	Product of iron reduction	1
Sulfate [and sulfide (S <sup>2-</sup> )]	F or L	Common anaerobic electron acceptor (product of sulfate reduction)	1
Sulfide (H <sub>2</sub> S)	F	Common product of sulfate reduction	1
Methane, ethane, ethene	L	Product of methanogenesis; daughter products of reductive dechlorination	1
Chloride	L	Ultimate daughter product of reductive dechlorination	1
TOC - upgradient groundwater	L	Electron donor	1
ORP, pH, specific conductance, temperature, turbidity	F	General water quality determination	1
Carbon dioxide (CO <sub>2</sub> )	F	Anaerobic electron acceptor (methanogenesis); biotic respiration indicator	2
Alkalinity/DIC	F	Buffering capacity; biotic respiration indicator	2
Hydrogen, dissolved	L	Fingerprint for characterizing electron acceptor pathway - indicator of what redox is occurring	2
TOC - upgradient soil	L	Input to analytical NA models; quantifies soil-water distribution coefficient and retardation factor	2
Volatile fatty acids	L	Determination of anthropogenic carbon used as an electron donor	3

Importance: 1=Most important; 3=Least important (depending on DQOs, all may be recommended).  
See Attachment E for details regarding analytical methods.

## ATTACHMENT D

### NATURAL ATTENUATION PARAMETERS FOR PETROLEUM HYDROCARBON PLUMES SCREENING PROCESS SUMMARY FOR OXIDATIVE (AEROBIC) DEGRADATION

Parameter	Field or Lab	Rationale	Importance
Volatile organic compounds	L	Source products; daughter products; electron donors (BTEX)	1
Dissolved oxygen	F	Primary electron acceptor (respiration); an/aerobic indicator	1
Nitrate (and nitrite), dissolved	F or L	Anaerobic electron acceptor (and product of nitrate reduction)	1
Manganese, dissolved	F or L	Anaerobic electron acceptor	1
Ferrous Iron ( $\text{Fe}^{2+}$ )	F	Product of iron reduction	1
Sulfate [and Sulfide ( $\text{S}^{-2}$ )]	F or L	Common anaerobic electron acceptor (product of sulfate reduction)	1
Sulfide ( $\text{H}_2\text{S}$ )	F	Common product of sulfate reduction	1
TOC - upgradient groundwater	L	Electron donor	1
ORP, pH, specific conductance temperature, turbidity	F	General water quality determination	1
Dissolved methane ( $\text{CH}_4$ )	L	Product of methanogenesis	1
Anions: chloride ( $\text{Cl}$ ), nitrate ( $\text{NO}_3$ ), nitrite ( $\text{NO}_2$ ), phosphate ( $\text{PO}_4$ ), sulfate ( $\text{SO}_4$ )	L		1
TOC - Upgradient soil	L	Input to analytical NA models; quantifies soil-water distribution coefficient and retardation factor	2
Biological oxygen demand (BOD)	L	Understanding of aquifer oxygen demand	3
Chemical oxygen demand (COD)	L	Understanding of aquifer oxygen demand	3

Importance: 1=Most important; 3=Least important (depending on DQOs, all may be recommended).



**ATTACHMENT E**  
**GEOCHEMICAL SAMPLING PARAMETERS - METHODS, EQUIPMENT, VOLUMES, CONTAINERS,**  
**PRESERVATION, HOLDING TIMES, AND DETECTION RANGES**  
**PAGE 1 OF 4**

Parameter	Method / Reference	Equipment / Method Chemistry	Sample Volume, Container, Preservation, & Holding Time	Range (mg/L)	Precision (mg/L)	Estimated Detection Limit (mg/L)
Alkalinity	CHEMetrics K-9810, K-9815, K-9820 -ASTM D 1067-92 -EPA 310.1	Titret® Titration Ampoules / Hydrochloric Acid, Phenolphthalein	Field. Follow test kit instructions. Avoid agitation and analyze at well head to determine total alkalinity. Filter if turbid (>10 NTU).	10-100 (K-9810) 50-500 (K-9815) 100-1000 (K-9820)	N/A	10 50 100
Alkalinity	Fixed-base lab -EPA 310.1	N/A	100 to 250 mL in glass or plastic container. Cool to 4°C. Analyze within 14 days. Filter if turbid.	N/A	N/A	N/A
Alkalinity / Dissolved Inorganic Carbon	HACH AL-DT -HACH 8203 -SM 2320 / SM 403	Digital Titration / Hydrochloric Acid, Phenolphthalein (P) and Total (M)	Field. Follow test kit instructions. Avoid agitation and analyze at well head to determine carbonate, bicarbonate, and hydroxide ions. Filter if turbid as recommended by manufacture. May use a pH meter for colored samples.	10-4000	N/A	10
Arsenic	Fixed-base lab -SW-6010 B	N/A	1 liter glass or polyethylene container, HNO <sub>3</sub> to pH ≤ 2, 6 months.	N/A	N/A	N/A
Biochemical Oxygen Demand	Fixed-base lab -EPA 410.1	N/A	2 liter HDPE. Cool to 4°C. Analyze within 48 hours.	N/A	N/A	N/A
Carbon Dioxide, dissolved	CHEMetrics K-1910, K-1920, K-1925 -ASTM D 513.82 -SM 4500-CO <sub>2</sub> -C	Titret® Titration Ampoules / Sodium Hydroxide, Phenolphthalein	Field. Follow test kit instructions. Avoid agitation and analyze at well head.	10-100 (K-1910) 100-1000 (K-1920) 250-2500 (K-1925)	N/A	10 100 250
Carbon Dioxide, dissolved	Fixed-base lab -VOA water sample (Vaportech)	GC-ECD/RGD/FID Detector	40 mL in VOA vial. 2 to 3 vials by (Vaportech).	N/A	N/A	N/A
Carbon Dioxide, dissolved	Fixed-base lab -Microseeps gas stripping cell	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required. Ship in glass septum vial (Microseeps only).	N/A	N/A	N/A
Carbon Dioxide, dissolved	HACH CA-DT -HACH 8205 -Mod. SM 406	Digital Titration / Sodium Hydroxide, Phenolphthalein	Field. Follow test kit instructions. Do not aerate or agitate. Analyze at well head.	10-1000	N/A	10
Chemical Oxygen Demand	Fixed-base lab -EPA 410.1	N/A	125 mL HDPE. H <sub>2</sub> SO <sub>4</sub> to pH <2.0. Cool to 4°C. Analyze within 28 days.	N/A	N/A	N/A
Chloride (Cl)	Fixed-base lab -EPA 300	N/A	100 to 250 mL in glass or plastic container. Cool to 4°C. Analyze within 28 days.	N/A	N/A	N/A
Chlorine - Total (Cl <sub>2</sub> )	HACH DR-850 -HACH 8167 -SM 4500-Cl	Colorimeter / DPD Method	Field. Follow test kit instructions.	0.02-2.00	± 0.01 mg/L with a 1.00 mg/L chlorine solution.	1
Conductance, Specific	Field Meter -SW-9050 A	Direct Reading Meter	100 to 250 mL in glass or plastic container. Analyze immediately.	N/A	N/A	N/A
Ethane, dissolved	Fixed-base lab -VOA water sample, Vaportech -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	40 mL in VOA vial. 2 to 3 vials by (Vaportech)	N/A	N/A	N/A
Ethane, dissolved	Fixed-base lab -Microseeps gas stripping cell -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required. Ship in glass septum vial (Microseeps only).	N/A	N/A	N/A

ATTACHMENT E

GEOCHEMICAL SAMPLING PARAMETERS - METHODS, EQUIPMENT, VOLUME, CONTAINER,  
 PRESERVATION, HOLDING TIME, AND DETECTION RANGES  
 PAGE 2 OF 4

Parameter	Method / Reference	Equipment / Method Chemistry	Sample Volume, Container, Preservation, & Holding Time	Range (mg/L)	Precision (mg/L)	Estimated Detection Limit (mg/L)
Ethene, dissolved	Fixed-base lab -VOA water sample, Vaportech -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	40 mL in VOA vial. 2 to 3 vials by (Vaportech).	N/A	N/A	N/A
Ethene, dissolved	Fixed-base lab -Microseeps gas stripping cell -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required. Ship in glass septum vial (Microseeps only).	N/A	N/A	N/A
Fraction Organic Carbon (foc) -Soil Upgradient Saturated Soil	Fixed-base lab -Walk-Black -SW-846 9060	N/A	200 gram glass jar. Cool to 4°C. Analyze within 14 days.	N/A	N/A	N/A
Hydrogen, dissolved	Fixed-base lab -Microseeps or Vapor Tech gas stripping cell -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required. Ship in glass septum vial.	N/A	N/A	N/A
Iron, ferrous (Fe <sup>2+</sup> )	HACH DR-850 -HACH 8146 -Mod. SM 315 B	Colorimeter 1, 10 Phenanthroline	Field. Follow test kit instructions. Analyze immediately at well head. Filter if turbid (>10 NTU) as recommended by the manufacture.	0-3.00	±0.017 mg/L with a 2.00 mg/L Fe <sup>2+</sup> solution.	0.03
Iron, ferrous (Fe <sup>2+</sup> )	HACH IR-18C -Mod. SM 315 B	Color Disc 1, 10 Phenanthroline	Field. Follow test kit instructions. Analyze immediately at well head. Filter if turbid (>10 NTU) as recommended by the manufacture.	0-10	N/A	0.2
Iron, total dissolved (Filtered)	Fixed-base lab -SW-846 6010B	N/A	250 mL in plastic container. Field filter to 0.45 µ. HCl to pH <2. Cool to 4°C. Analyze within 6 months.	N/A	N/A	N/A
Manganese (Mn <sup>2+</sup> )	HACH DR-850 -HACH 8034 -CFR 44(116) 34193	Colorimeter / Cold Periodate Oxidation	Field. Follow test kit instructions. Avoid agitation and analyze at well head. Filter if turbid as recommended by the manufacture.	0-20.0	± 0.18 mg/L with a 10.00 mg/L Mn solution.	0.12
Manganese (Mn <sup>2+</sup> )	HACH MN-5 -Mod. SM 319 B -CFR 44(116) 34193	Color Disc / Cold Periodate Oxidation	Field. Follow test kit instructions. Avoid agitation and analyze at well head. Filter if turbid as recommended by the manufacture.	0-3	N/A	0.1
Manganese, total dissolved (Filtered)	Fixed-base lab -SW-846 6010B	N/A	250 mL in plastic container. Field filter to 0.45 µ. HCl to pH <2. Cool to 4°C. Analyze within 6 months.	N/A	N/A	N/A
Methane, dissolved	Fixed-base lab -VOA water sample, Vaportech -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	40 mL in VOA vial. 2 to 3 vials by (Vaportech).	N/A	N/A	N/A
Methane, dissolved	Fixed-base lab -Microseeps gas stripping cell -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required. Ship in glass septum vial (Microseeps only).	N/A	N/A	N/A
Nitrate (NO <sub>3</sub> <sup>-</sup> )	Fixed-base lab -EPA 300	N/A	250 mL plastic container. Cool to 4°C. Analyze within 48 hours.	N/A	N/A	N/A
Nitrate (NO <sub>3</sub> <sup>-</sup> )	HACH DR-850 -HACH 8192 -Mod. EPA 353.2	Colorimeter / Cadmium Reduction	Field. Follow test kit instructions. Avoid agitation and analyze at well head. Pretreatment required if nitrite is present.	0-0.50	± 0.03 mg/L with a 0.25 mg/L of nitrate nitrogen (NO <sub>3</sub> <sup>-</sup> N) solution.	0.01
Nitrite (NO <sub>2</sub> <sup>-</sup> )	Fixed-base lab -EPA 300	N/A	250 mL plastic container. Cool to 4°C. Analyze within 48 hours. Filter if turbid as recommended by the manufacture.	N/A	N/A	N/A

ATTACHMENT E

GEOCHEMICAL SAMPLING PARAMETERS - METHODS, EQUIPMENT, VOLUME, CONTAINER,  
PRESERVATION, HOLDING TIME, AND DETECTION RANGES  
PAGE 3 OF 4

Parameter	Method / Reference	Equipment / Method Chemistry	Sample Volume, Container, Preservation, & Holding Time	Range (mg/L)	Precision (mg/L)	Estimated Detection Limit (mg/L)
Nitrite (NO <sub>2</sub> <sup>-</sup> )	HACH DR-850 -HACH 8507 -Mod. EPA 354.1 -Mod. SM 419 -CFR 44(85) 25695	Colorimeter / Diazotization	Field. Follow test kit instructions. Avoid agitation and analyze at well head. Filter if turbid as recommended by the manufacture.	0-0.350	± 0.001 mg/L with a 0.250 mg/L nitrite nitrogen solution.	0.005
Nitrogen, dissolved	Fixed-base lab -Microseeps gas stripping cell -Vaportech VOA water sample	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required for Microseeps. Ship in glass septum vial (Microseeps) or VOA vial (Vaportech).	N/A	N/A	N/A
Nitrogen, Total Kjeldahl	Fixed-base lab -EPA 351.2	N/A	500 mL plastic/glass container. Cool to 4°C. H <sub>2</sub> SO <sub>4</sub> to pH ≤ 2. Analyze within 28 days.	N/A	N/A	N/A
Oxidation Reduction Potential	Field Meter - ASTM D-1498	Direct Reading Meter	Field. Do not aerate. Gently agitate probe using flow over or flow-through method. Analyze immediately at well head.	N/A	N/A	N/A
Oxygen, dissolved	CHEMetrics K-7501, K-7512 -ASTM D 5543-94 -ASTM D 887-92	CHEMetrics® Vacuum Vials / Rhodazine D and Indigo Carmine	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head.	0-1 (K-7501) 1-12 (K-7512)	N/A	0.025 1
Oxygen, dissolved	Fixed-base lab -VOA water sample, Vaportech -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	40 mL in VOA vial. 2 to 3 vials by (Vaportech).	N/A	N/A	N/A
Oxygen, dissolved	Fixed-base lab -Microseeps gas stripping cell -RSK SOP-147 & 175	GC-ECD/RGD/FID Detector	Field bubble-strip sampling required. Ship in glass septum vial (Microseeps only).	N/A	N/A	N/A
Oxygen, dissolved	HACH OX-DT -HACH 8215 -SM 4500-O-G	Digital Titration / Azide Modification of Winkler Digital Titration Method	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head.	1-10	N/A	1
Oxygen, dissolved	HACH DR-850 (AccuVac Ampules) LR HRDO Method	-Indigo Carmine Method -Rhodazine D Method	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head.	0-0.8 ppm 0-10 ppm	0.01 ppm 0.1 ppm	N/A
Oxygen, dissolved	Field Meter	Direct Reading Meter	Analyze immediately at well head. Avoid agitation and analyze immediately at well head. Used for well stabilization measurement parameter only.	N/A	N/A	N/A
pH	Field Meter -SW 9040B	Direct Reading Meter	Analyze immediately at well head.	N/A	N/A	N/A
Phosphate (ortho)	Fixed-base lab -EPA 300	Ion Chromatography	250 mL plastic container. Cool to 4°C. Analyze within 48 hours. Filter if turbid as recommended by the manufacture.	N/A	N/A	N/A
Phosphate, potassium	Fixed-base lab -SW-846 8010B	Inductively Coupled Plasma	250 mL plastic container. Cool to 4°C. Analyze within 48 hours. Filter if turbid as recommended by the manufacture.	N/A	N/A	N/A
Salinity	Field Meter	Direct Reading Meter	Analyze immediately.	N/A	N/A	N/A
Sulfate (SO <sub>4</sub> <sup>-2</sup> )	Fixed-base lab	N/A	250 mL plastic container. Cool to 4°C. Analyze within 48 hours. Filter if turbid as recommended by the manufacture.	N/A	N/A	N/A
Sulfate (SO <sub>4</sub> <sup>-2</sup> )	HACH DR-850 -HACH 8051 -EPA 375.4	Colorimeter / Turbimetric SulfaVer 4	Field. Follow test kit instructions. Filter if turbid as recommended by the manufacture.	0-70	± 0.5 mg/L with a 50 mg/L sulfate solution.	4.9
Sulfide (Hydrogen Sulfide, H <sub>2</sub> S)	HACH H-S-C -HACH Proprietary -Mod. SM 428 C	Color Chart / Effervescence of H <sub>2</sub> S through sulfide reactive paper	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head.	0-5	N/A	0.1
Sulfide (S <sup>-2</sup> )	CHEMetrics K-9510 -SM 4500-S <sup>2</sup>	CHEMetrics® Vacuum Vials / Methylene Blue	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head.	0-1 1-10	N/A	0.1 1

ATTACHMENT E

GEOCHEMICAL SAMPLING PARAMETERS - METHODS, EQUIPMENT, VOLUME, CONTAINER,  
 PRESERVATION, HOLDING TIME, AND DETECTION RANGES  
 PAGE 4 OF 4

Parameter	Method / Reference	Equipment / Method Chemistry	Sample Volume, Container, Preservation, & Holding Time	Range (mg/L)	Precision (mg/L)	Estimated Detection Limit (mg/L)
Sulfide ( $S^{2-}$ )	Fixed-base lab -EPA 376.1/376.2	N/A	1 liter in plastic container, no headspace. NaOH to pH >9. Cool to 4°C. Avoid agitation and analyze within 7 days.	N/A	N/A	N/A
Sulfide ( $S^{2-}$ )	HACH DR-850 +HACH 8131 -SM 4500-S <sup>2</sup>	Colorimeter / Methylene Blue	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head. Pretreatment required for turbid samples as recommended by the manufacture.	0-0.70	± 0.02 mg/L with a 0.73 mg/L sulfide solution.	0.01
Sulfide ( $S^{2-}$ )	HACH HS-WR -SM 4500-S <sup>2</sup>	Color Disc / Methylene Blue	Field. Follow test kit instructions. Avoid agitation and analyze immediately at well head. Pretreatment required for turbid samples as recommended by the manufacture.	0-11.25	N/A	0.1-2.5
Temperature	Field Meter / Thermometer - E 170.1	Direct Reading Meter / Thermometer	Analyze immediately.	N/A	N/A	N/A
Total Organic Carbon (TOC)-Groundwater	Fixed-base lab - E 415.1	N/A	125 mL HDPE. H <sub>2</sub> SO <sub>4</sub> to pH < 2.0. Cool to 4°C. Analyze within 28 days.	N/A	N/A	N/A
Turbidity	Field Meter - E 180.1	Direct Reading Meter	Analyze immediately.	N/A	N/A	N/A

N/A = Not applicable.

## **APPENDIX VII**

### **HEALTH AND SAFETY PLAN**

**Health and Safety Plan  
for  
Remedial Investigation  
and  
Risk Assessment  
at  
Site 22 Building 105 Old Dry Cleaning  
Facility**

**Naval Training Center  
Great Lakes  
Great Lakes, Illinois**



**Southern Division  
Naval Facilities Engineering Command  
Contract No. N62467-94-D-0888  
Contract Task Order 0154/0290**

July 2001  
Revised July 2002  
Revised June 2003

**HEALTH AND SAFETY PLAN  
for  
REMEDIAL INVESTIGATION  
and  
RISK ASSESSMENT  
at  
SITE 22 – BUILDING 105 OLD DRY CLEANING FACILITY  
  
NAVAL TRAINING CENTER GREAT LAKES  
GREAT LAKES, ILLINOIS**

**COMPREHENSIVE LONG-TERM  
ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT**


**Submitted to:  
Southern Division  
Naval Facilities Engineering Command  
2155 Eagle Drive  
North Charleston, South Carolina 29406**

**Submitted by:  
Tetra Tech NUS, Inc.  
661 Andersen Drive  
Pittsburgh, Pennsylvania 15220**


**CONTRACT NUMBER N62467-94-D-0888  
CONTRACT TASK ORDER 0154/0290**

**JULY 2001  
Revised July 2002  
Revised June 2003**

**PREPARED UNDER THE  
SUPERVISION OF:**

  
\_\_\_\_\_  
**ROBERT DAVIS, P.E.  
TASK ORDER MANAGER  
TETRA TECH NUS, INC.  
PITTSBURGH, PENNSYLVANIA**

**APPROVED FOR SUBMITTAL BY:**

  
\_\_\_\_\_  
**MATTHEW M. SOLTIS, CIH, CSP  
CLEAN HEALTH & SAFETY MANAGER  
TETRA TECH NUS, INC.  
PITTSBURGH, PENNSYLVANIA**

## TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
<b>1.0 INTRODUCTION.....</b>	<b>IX-VII-1</b>
1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS .....	IX-VII-2
<b>2.0 EMERGENCY ACTION PLAN .....</b>	<b>IX-VII-4</b>
2.3.1 Drilling Activities .....	IX-VII-4
2.5.2 Life Threatening .....	IX-VII-4
2.7 EMERGENCY CONTACTS .....	IX-VII-5
2.8 ROUTE TO HOSPITALS.....	IX-VII-6
<b>3.0 SITE BACKGROUND AND DESCRIPTION .....</b>	<b>IX-VII-8</b>
3.1.3 Site 22 – Building 105 Old Dry Cleaner Facility.....	IX-VII-8
<b>6.0 HAZARD ASSESSMENT .....</b>	<b>IX-VII-11</b>
6.1 CHEMICAL HAZARDS .....	IX-VII-11
<b>7.0 HAZARD MONITORING .....</b>	<b>IX-VII-12</b>

## TABLES

<u>Section</u>	<u>Page</u>
2-1 Emergency Contacts .....	IX-VII-5
5-1 Tasks/Hazards/Control Measures Compendium .....	IX-VII-9



## 1.0 INTRODUCTION

This Health and Safety Plan (HASP) is an addendum to the existing HASP (Appendix VII and VIII) in the existing Quality Assurance Project Plan (QAPP) (TtNUS, 2001) for NTC Great lakes and encompasses the activities that are to be conducted at Site 22 - Building 105 Old Dry Cleaning Facility for the Remedial Investigation and Risk Assessment activities. The investigation at Site 22 will be similar to the investigation at Site 7. Changes to the existing HASP will be noted in the text below for the Site 22 - Building 105, Old Dry Cleaning Facility investigation. Tetra Tech NUS, Inc. (TtNUS) will conduct these activities under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Contract Number N62467-94-D-0888, in accordance with the statement of work for Contract Task Order (CTO) 290 at the Naval Training Center (NTC) Great Lakes, Illinois.

Site activities to be conducted at NTC Great Lakes Site 22 include the following (see Section 4.0 for a detailed description):

- Mobilization/demobilization
- Monitoring Well Installation/Construction. Methods employed include:
  - Direct Push Technique
  - Hollow Stem Auger
- Multi-media Sampling including:
  - Surface soil sampling
  - Subsurface soil sampling (well installation)
  - Ground water sampling
  - New permanent monitoring wells
- Equipment decontamination
- Aquifer Testing – Slug Testing
- Ground water level measurements
- Investigation-derived waste handling and disposal
- Site Restoration
- Land Surveying of Sample Locations

## 1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

**Site Name:** NTC Great Lakes **Address:** EFA Midwest  
 Building 1A, Code N457  
 201 Decatur Avenue  
 Great Lakes, IL 60088

**NTC Great Lakes Point of Contact:** Mr. Dan Fleming or Mr. Mark Schultz

**Phone Number:** Dan - (847) 688-5999 x 161 **E-Mail:** flemingdm@EFDSOUTH.NAVFAC.NAVY.mil

**Phone Number:** Mark - (847) 688-5999 x 140 **E-Mail:** schultzmr@pwcgl.navfac.navy.mil

**Fax Number:** (847) 688-2319

**U.S. Navy Remedial Project Manager/Engineer-In-Charge:** Anthony Robinson (Code 18511)

**Address:** 2155 Eagle Drive  
 North Charleston, South Carolina 29406 **Phone Number:** (843) 820-7339  
**Fax Number:** (843) 820-7465  
**E-mail Address:** robinsonab@efdsouth.navfac.navy.mil

**Base Pass and Security:** Building 130 (near Main Gate); Hours of Operation 0600 – 1800

**Phone Number:** (847) 688-5648

Note: See Section 9.5.1 for Base Access Information.

**Purpose of Site Visit:** This activity is divided into a multi-task operation (see Section 4.0), including Direct Push Technology [DPT] soil borings, monitoring well and piezometer installation, and multi-media sampling, and other related activities.

**Proposed Dates of Work:** July 2003 until September 2003

### Project Team:

<b>Tetra Tech NUS Personnel:</b>	<b>Discipline/Tasks Assigned:</b>	<b>Phone No.</b>
<u>Robert Davis, P.E.</u>	<u>Task Order Manager</u>	<u>(412) 921-7251 davisb@ttnus.com</u>
<u>Aaron Bernhardt</u>	<u>Assistant Task Order Manager/Ecological</u>	<u>(412) 921-8433 bernhardta@ttnus.com</u>
<u>Matthew M. Soltis, CIH, CSP</u>	<u>CLEAN Health and Safety Manager</u>	<u>(412) 921-8912 soltism@ttnus.com</u>
<u>Thomas M. Dickson, CSP</u>	<u>Project Health and Safety Officer</u>	<u>(412) 921-8457 dicksont@ttnus.com</u>
<u>Bob Balkovec</u>	<u>Project Geologist/Field Operations Leader (FOL)</u>	<u>(412) 921-8616 balkovecb@ttnus.com</u>
<u>Tom Patton</u>	<u>Equipment Manager</u>	<u>(412) 859-4670</u>

**Project Support Team:**

<b>Tetra Tech NUS Personnel:</b>	<b>Discipline/Tasks Assigned:</b>	<b>Phone No./E-mail</b>
<u>Tom Jackman</u>	<u>Human Health Risk Assessment</u>	<u>(412) 921-8724</u> <u>jackmant@ttnus.com</u>
<u>Angie Scheetz</u>	<u>Project Chemist</u>	<u>(412) 921-7271</u> <u>scheetza@ttnus.com</u>
<u>Judy Lamey</u>	<u>GIS/Database/Information Technology</u>	<u>(412) 921-8678</u> <u>lameyj@ttnus.com</u>
<u>Tom Johnston</u>	<u>DQOs, QAPP</u>	<u>(412) 921-8615</u> <u>johnstont@ttnus.com</u>

Non-Tetra Tech NUS Personnel	Affiliation/Discipline/Tasks Assigned	Phone No#.
<u>Severn Trent Laboratories</u>	<u>Analytical Laboratory</u>	<u>(412) 820-2148</u>
<u>TBD</u>	<u>Surveyor (Geographical)</u>	<u></u>
<u>TBD</u>	<u>Drilling/DPT Subcontractor</u>	<u></u>
<u>FedEx</u>	<u>Sample/Parcel Delivery</u>	<u>1(800)463-3339</u>

**Project Regulatory Oversight/Support:**

**U.S. EPA Region 5, EPA RPM:** Owen Thompson      **Phone Number:** (312) 886-4843  
**Address:** 77 W. Jackson Blvd      **Fax Number:** (312) 353-8426  
 Chicago, IL 60604-3507      **E-mail:** thompson.owen@epa.gov

**IEPA, Bureau of Land,  
IEPA RPM:** Brian Conrath  
**Address:** 1021 N. Grand Avenue East  
Springfield, IL 62702  
**Phone Number:** (217) 557-8155  
**Fax Number:** (217) 782-3258  
**E-mail:** brian.conrath@epa.state.il.us

## IEPA

**IEPA Office of Chemical Safety**  
**Environmental Toxicologist:** Leslie Morrow  
**Address:** 1021 N. Grand Avenue East  
 Springfield, IL 62702

**Phone Number:** (217) 782-9292  
**Fax Number:** (217) 782-3258  
**E-mail:** les.morrow@epa.state.il.us

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation conducted by:

Thomas M. Dickson, CSP

## **2.0 EMERGENCY ACTION PLAN**

### **2.3.1 Drilling Activities**

**Struck By** – In 2001, a person from Tetra Tech Inc. experienced an injury when a high pressurized line released from its connection and struck the person in the head. This injury could possibly have been prevented by following these recommendations:

Inspect all equipment arriving onsite. Pay particular attention to guarding surrounding high pressure lines especially those that separates the lines and nearby operators. For those high pressure lines without physical barriers/guards between the operator and the lines insure these lines have cable links to prevent the line from becoming separated from its connection.

### **2.5.2 Life Threatening**

- Have one person notify off-site response agencies and Engage Emergency Notification Sequence
- If it will not endanger the injured individual (i.e., spinal cord injury, etc.) remove any outer PPE. Removal may require the use of bandage scissors to remove the outer garments.
- Begin life saving techniques as appropriate (CPR, cooling or warming regimens, etc.).
- Wrap the injured in a blanket for transport to the hospital.
- Follow instructions provided in Figure 2-1.

**TABLE 2-1**  
**EMERGENCY CONTACTS**  
**NTC GREAT LAKES**

<b>AGENCY</b>	<b>TELEPHONE</b>
EMERGENCY (Police, Fire, and Ambulance Services)	911*
Non-Emergency (Police, Fire, and Ambulance Services)	(847) 688-3430
U.S. Navy Remedial Project Manager/Engineer-in-Charge – Mr. Anthony Robinson	(843) 820-7339
U.S. Navy/NTC Great Lakes Point of Contact – Mr. Dan Fleming	(847) 688-5999 Ext. 161
Great Lakes Naval Hospital (Primary)	911 (Primary) (847) 688-4560 Duty Officer (847) 688-5555 Ambulance (847) 688-5618 Emergency
TtNUS Task Order Manager - Robert Davis	(412) 921-7251
CLEAN Health and Safety Manager – Matthew M. Soltis	(412) 921-8912
Project Health and Safety Officer - Tom Dickson	(412) 921-8457
WorkCare (TtNUS Healthcare Provider)	1-800-455-6155 Ext. 109 Fax (714) 456-2154
Utility Location (15 Working Days Advance Notification Required) Ms. Judy Jarosz (Primary) Mr. Chuck Kelly (Back-up)	(847) 688-2121 Ext. 18 (847) 688-2121 Ext. 10
Utility Emergency – Public Works Dept. – NTC Great Lakes (Monday – Friday 0700 – 1630) Trouble Desk (Holidays and Saturday/Sundays)	(847) 688-3849  (847) 688-4820

\* - Cellular communications will be routed through Lake County Dispatch. It is imperative that you inform them that you are calling from the NTC Great Lakes facility. 911 will work from any Base extension.





For emergency care only, non-Navy personnel are permitted to go to the Navy Hospital.

Great Lakes Naval Hospital  
3001A Sixth Street  
Great Lakes, Illinois 60088-2833  
(Sheridan Road and South Gate Entrance)

(847) 688-4560 Duty Officer  
(847) 688-5555 Ambulance  
(847) 688-5618 Emergency

From Site 22 - Building 105 – Former Dry Cleaning Facility

1. Exit Site 22 Turn Right onto Sampson Street (South).
2. The hospital is on the left
3. Follow signs to the appropriate entrance to the hospital (3001A Sixth Street).

### 3.0 SITE BACKGROUND AND DESCRIPTION

#### 3.1.3 Site 22 - Building 105 Old Dry Cleaning Facility

Building 105 is located at the NTC Great Lakes in Lake County, Illinois. NTC Great Lakes (EPA # IL7170024577) has operated with Resource Conservation and Recovery Act (RCRA) interim status authorization since November 19, 1980. Building 105 was originally included in a RCRA Part A permit that has been modified over the past 25 years.

Building 105 was constructed in 1939 and was utilized as a dry cleaning facility until 1993 or 1994 when it was converted to a vending machine supply and repair station. The RCRA unit consisted of a slab-on-grade building measuring approximately 150 feet by 70 feet. The 10,500-square foot building occupied a lot approximately 250 feet by 115 feet. Building 105 was actively used to warehouse and repair vending equipment and vending products until February 2001. The building was demolished in March 2003.

Soil and groundwater sampling has taken place at Building 105 as documented in the Partial Closure Certification and Sampling/Inspection Report (PCC&SIR). The contaminants of concern and maximum detected concentrations in the soil and groundwater are as follows:

Contaminant of Concern	Maximum Concentration Recorded
Tetrachloroethene (PCE)	1,500 mg/kg (soil); 7,400 ug/l (groundwater)
cis-1,2-Dichloroethene (DCE)	820 ug/kg ; 3,200 ug/L

The "hot spot" is apparently located on the southern and eastern sides of the building along Sampson Street. The extent of the PCE and DCE plume will be further defined when permanent groundwater wells are installed around Site 22 as part of this investigation.



Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment (Items in <i>italics&gt; are deemed optional as conditions or the FOL or SSO dictate.)</i>	Decontamination Procedures
<p>Hollow Stem Auger and Direct Push Drilling Operations including:</p> <ul style="list-style-type: none"> <li>Soil borings</li> <li>Monitoring Well Installations</li> <li>Piezometer Installations</li> </ul> <p>DPT - This activity employs hydraulic pressure and percussion hammer to advance tooling into the ground.</p> <p>This activity is planned for the following locations:</p> <ul style="list-style-type: none"> <li>Soil borings – 6 at Site 7</li> <li>Monitoring Well Installations – 5 to be installed at Site 7</li> <li>Piezometer Installations – 3 of the 6 soil borings at Site 7 will be converted to piezometers</li> </ul> <p>This activity will also include the well and piezometer abandonment activity.</p> <p>Bldg.105</p> <p>Eleven soil borings and eleven monitoring wells to be installed.</p>	<p><b>Chemical hazards:</b></p> <p>1) Previous analytical data available for the work areas did not identify contaminants in sufficient concentrations to establish occupational exposure threat. General categories of site contaminants include:</p> <ul style="list-style-type: none"> <li>PAHs</li> <li>Metals</li> <li>Pesticides/PCBs</li> </ul> <p>Bldg. 105</p> <ul style="list-style-type: none"> <li>PCE</li> <li>DCE</li> </ul> <p>Further information on these categories of contaminants are provided in Section 6.1.</p> <p>2) Transfer of contamination into clean areas or onto persons</p> <p><b>Physical hazards:</b></p> <p>3) Heavy equipment hazards (pinch/compressions points, rotating equipment, hydraulic lines, etc.)</p> <p>4) Noise in excess of 85 dBA</p> <p>5) Energized systems (contact with underground or overhead utilities)</p> <p>6) Lifting (strain/muscle pulls)</p> <p>7) Slips, trips, and falls</p> <p>8) Cuts and lacerations</p> <p>9) Vehicular and foot traffic</p> <p>Further information on these physical hazards, see Section 6.2 for further discussions.</p> <p><b>Natural hazards:</b></p> <p>10) Inclement weather</p>	<p><b>Chemical hazards:</b></p> <p>1) Safe work practices will be employed as the first line of defense. As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) will be employed as a universal control measure.</p> <p><b>Particulates/Liquids with an Elevated Boiling Temperature</b> -As some of the materials in question are solids ( Site 7 i.e., naphthalenic distillates (PAHs), metals, pesticides/PCBs) and/or bound to particulates, the next control measure to be employed to minimize potential exposure will be good work and personal hygiene practices. These control measures including avoiding hand-to-mouth contact to the extent possible, washing hands and face or using hygienic wipes to remove potential contaminants from hands and face prior to breaks or lunch or other hand to mouth activities will restrict the most predominant route of exposure. Dust suppression methods including area wetting will be employed to control mechanically generated dust emissions.</p> <p><b>Liquids/gases</b> – In situations where contaminants exist in soils or liquid media and presents a vapor or gas hazard threat as is the case with Bldg. 105, real time monitoring instruments and PPE will be employed to support protective measures. As part of the evaluation method, all samples will be scanned with a PID to determined potential source concentrations.</p> <p>2) <b>Transfer of Contamination into Clean Areas or onto Persons</b> - Restrict the cross use of equipment and supplies between locations and activities without first going through a suitable decontamination. Work practices including:</p> <ul style="list-style-type: none"> <li>A rigid decontamination procedure will be employed for all equipment between locations and between clean and potentially dirty work. This provision along with dedicated sampling equipment will insure materials are not carried and deposited in unaffected areas.</li> </ul> <p><b>Physical hazards:</b></p> <p>3) <b>Heavy Equipment Hazards</b> - All equipment will be:</p> <ul style="list-style-type: none"> <li>Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600.601.602), and manufacturer's design, as applicable. All inspections will be documented using the Equipment Inspection Checklist found in (See Attachment III) of this HASP.</li> <li>Operated and supported by certified operators and knowledgeable ground crew.</li> <li>Used within safe work zones, with routes of approach clearly demarcated. All personnel not directly supporting this operation will remain at least 25 feet from the point of operation. See Section 9.0 of this HASP. This will be the area identified as the exclusion zone.</li> <li>All self-propelled equipment shall be equipped with movement warning systems.</li> <li>All personnel will be instructed in the location and operations of the emergency shut-off device(s). This device will be tested initially (and then periodically) to ensure its operational status.</li> <li>Areas will be inspected prior to the movement of the direct push rig and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO.</li> <li>The direct push, drill rigs, and support vehicles will be moved no closer than 5-feet to unsupported side-walls of excavations and embankments.</li> <li>See additional safe work procedures for drilling in Section 5.2 of this HASP.</li> </ul> <p>4) <b>Noise in Excess of 85 dBA</b> - Hearing protection will be used during all subsurface activities using the HAS drill and direct push rig or when noise levels are &gt;85 dBA. (during operation). Previous accumulated data indicates an average 8 hour exposure working behind a direct push rig during hydraulic and hammer advancement of the tooling is approximately 90-102 dBA.. The HSA Drill rig averaged 89-96dBA. Controlling this hazard shall be accomplished employing two separate approaches as follows:</p> <ul style="list-style-type: none"> <li>Boundaries will be established to limit the affect of the noise hazard. Typically, the height of the mast + 5 feet or a minimum of 25 feet is normal for DPT rigs, and the height of the mast plus 5-feet is suitable for the HSA Drill Rig.</li> <li>Hearing protection – As a general rule of thumb, hearing protection will be employed when</li> </ul> <p><i>Excessive noise levels (&gt;80dBA) are being approach when you have to raise your voice to talk to someone within 2 feet of your location.</i></p> <p>5) <b>Energized Systems</b> - All drilling activities will proceed in accordance with the Utility Locating and Excavation Clearance SOP in Attachment II of this HASP. All utility clearances will be obtained, in writing, and locations identified and marked, prior to activities. If it is not obtainable/unknown or the location infringes within 3-feet of an underground utility advancement must proceed by hand until past the utility. The hand dug hole should represent the same diameter of the mechanized tooling that will enter the subsurface media.</p> <p>6) <b>Lifting Hazards</b> - Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques as described in mobilization/demobilization, Table 5-1.</p> <p>7) <b>Slips, Trips, and Falls</b> - Preview work locations for unstable/uneven terrain.</p> <ul style="list-style-type: none"> <li>Cover, guard and barricade all open pits, ditches, and floor opening as necessary.</li> <li>Ruts, roots, tools, and other tripping hazards should be eliminated approaching points of operation to minimize trips and falls when approaching operating equipment.</li> <li>Maintain a clutter free work area.</li> <li>As part of site control efforts construct fences or other means of demarcation (i.e. signs and postings) to control and isolate traffic in the work area. Means of demarcation shall also be constructed isolating resource and/or staging areas.</li> </ul> <p>8) <b>Cuts and Lacerations</b> - To prevent cuts and lacerations associated with extracting samples from the acetate liners of the Macro-Core Sampling System , the following provisions are required:</p> <ul style="list-style-type: none"> <li>Obtain and use the knife and acetate tube retention tub recommended by Geoprobe to prevent accidents of this nature. These items have been engineered to allow sample acquisition without putting the sampler at risk.</li> <li>Always cut away from yourself and others, then, if a knife slips, you will not impale yourself or others.</li> <li>Do not place items to be cut in your hand or on your knee.</li> <li>Change out blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.</li> </ul> <p>9) <b>Vehicular and Foot Traffic Hazards</b> - Use traffic-warning signs, flag persons, and high visibility vests as determined by the SSO when working along traffic thoroughfares. In addition, use physical barricades, when working within normal traffic flow patterns/traffic lanes.</p> <p><b>Natural hazards:</b></p> <p>10) <b>Inclement Weather</b> – To minimize hazards of this type, the following provisions shall be employed:</p> <ul style="list-style-type: none"> <li>Wear appropriate clothing for weather conditions.</li> <li>Provide acceptable shelter and replacement liquids for field crews as relief from excessive ambient temperatures.</li> <li>Under conditions of elevated levels of PPE, periods of acclimatization, excessive ambient temperature extremes, or if you believe someone is suffering from a heat/cold related disorder, it may be necessary to conduct heat/cold stress monitoring.</li> <li>Electrical storms/high winds - Suspend or terminate operations until directed otherwise by SSO.</li> </ul> <p>Follow the provisions as specified in Section 4.0 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual regarding the identification and evaluation of heat/cold stress related conditions.</p>	<p>1) Monitoring shall be conducted to as a general screening effort to qualify and quantify estimated source concentrations of site contaminants in support of the prescribed worker protection levels.</p> <p>Monitoring shall be conducted using a Photoionization Detector (PID) with 10.6eV lamp strength.</p> <p><b>Site 7</b></p> <ul style="list-style-type: none"> <li>10 ppm in the workers breathing zone for no greater than 10 minutes duration, no more than 4 occurrences in a single day. Action levels of this level will protect personnel from achieving the most conservative TLV/TWA.</li> <li>Dusts/particulates – All dust/particulate concentrations will be maintained to below visual recognition which is estimated at 2 mg/m<sup>3</sup>.</li> </ul> <p><b>Bldg. 105</b></p> <ul style="list-style-type: none"> <li>10 ppm in the workers breathing zone.</li> <li>Dusts/particulates – All dust/particulate concentrations will be maintained to below visual recognition which is estimated at 2 mg/m<sup>3</sup>.</li> </ul> <p>Concentration in excess of these action levels require personnel to stop work and notify PHSO.</p> <p>Monitoring shall be conducted at the prescribed depths as indicated on the boring logs at the source (borehole) and drillers breathing zone. Monitoring shall also be conducted at the samplers location in the same prescribed frequency when handling samples.</p> <p>Noise monitoring will be conducted at the discretion of the PHSO and/or the SSO.</p> <p>Action Level - &gt;85 dBA Participation in the Project Hearing Conservation Program. Hearing protection is required for this operation.</p> <p>Noise level measurements of greater than 105dBA will require the use of combination plugs and muff for noise protection.</p> <p>All sound level measurements and noise dosimetry should proceed in accordance with the project Hearing Conservation Program(See Attachment VI).</p>	<p>All soil boring and monitoring well installation operations will be initiated in Level D protection, including the following articles:</p> <p><b>Sampler/Oversight Personnel</b></p> <ul style="list-style-type: none"> <li>Standard field dress (long pants, Sleeved shirts)</li> <li>Steel toe safety shoes or work boots</li> <li>Hard hat(when within the established site control boundaries of the drill or direct push rig or when sampling)</li> <li>Safety Glasses(when within the established site control boundaries of the drill or direct push rig or when sampling)</li> <li>Nitrile surgeon style inner gloves for sampling</li> <li>Hearing protection(when within established boundaries of an operating direct push and/or drill rig)</li> <li>Impermeable boot covers</li> <li>Reflective vest for traffic areas</li> </ul> <p><b>Driller and Driller Helper</b></p> <ul style="list-style-type: none"> <li>Standard field attire including sleeved shirt and long pants</li> <li>Safety shoes (Steel toe/shank)</li> <li>Safety glasses</li> <li>Nitrile inner and outer gloves or equivalent protection</li> <li>Hearing protection</li> <li>Hard hat</li> <li>Impermeable aprons are recommended for handling MacroCore Samplers and auger flights to prevent soiling work clothes</li> <li>Impermeable boot covers</li> </ul> <p>As site conditions may change, the following equipment will be maintained during all on-site activities</p> <ul style="list-style-type: none"> <li>Fire Extinguishers</li> <li>First-aid Kit</li> <li>Portable Eyewash. This is required during well/piezometer abandonment due to the caustic nature of the Portland Cement.</li> </ul> <p><b>Note:</b> The Safe Work Permit(s) for this task (See Attachment IV of this HASP) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.</p>	<p><b>Personnel Decontamination</b> will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, impermeable apron, as applicable)</p> <p>Gross contamination of outer boots and outer gloves will be removed at a satellite location near the operation. Final wash and rinse will take place at the centralized decontamination pad. The sequential procedure is as follows:</p> <p>Stage 1: Remove visible materials from hand tools, wash with soap and water.</p> <p>Stage 2: Soap/water wash and rinse of outer boots (as necessary) and gloves</p> <p>Stage 3: Soap/water wash and rinse of the impermeable apron, as applicable.</p> <p>Stage 4: Disposable PPE will be removed and bagged.</p> <p>Stage 5: Wash face and hands</p> <p><b>Note:</b> For remote locations away from the centralized decontamination unit</p> <ul style="list-style-type: none"> <li>Bag and/or wrap all disposable and reusable equipment, respectively for transport back to the decontamination unit.</li> <li>Hygienic wipes may be used for cleaning hands and face</li> </ul> <p><b>Equipment Decontamination</b> - All heavy and sampling equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner or pressure washer as prescribed in Table 5-1 for that task. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones. Vehicles will have their wheels/tires cleaned or sprayed off as applicable as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity.</p> <p>The FOL or the SSO will be responsible for evaluating equipment arriving on-site, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.</p>

Task/Operation/ Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment (Items in <i>italics&gt; are deemed optional as conditions or the FOL or SSO dictate.)</i>	Decontamination Procedures
<p>Multi-media sampling, including</p> <ul style="list-style-type: none"><li>- Surface water – direct pour or pump</li><li>- Ground water – Peristaltic/bladder pumps</li><li>- Surface soils and sediments – Trowel</li><li>- Subsurface soils – hand auger, soil corers, and mechanized support (See Soil boring Table 5-1).</li><li>- IDW – Trowel, soil corer, or pump.</li></ul> <p>Protective measures as recommended here shall also apply to aquifer development and hydraulic conductivity testing.</p>	<p><b>Chemical hazards:</b></p> <p>1) Site 7 Previous analytical data available for the work areas did not identify contaminants in sufficient concentrations to establish a significant occupational threat. General categories include</p> <ul style="list-style-type: none"><li>- PAHs</li><li>- Metals</li><li>- Pesticides/PCBs</li></ul> <p>Bldg. 105</p> <ul style="list-style-type: none"><li>- PCE</li><li>- DCE</li></ul> <p>Further information on these categories of contaminants are provided in Section 6.1.</p> <p>2) Transfer of contamination into clean areas.</p> <p><b>Physical hazards:</b></p> <p>3) Slip, trip, and fall hazards</p> <p>4) Strain/muscle pulls from manual lifting</p> <p>5) Cuts and Lacerations</p> <p>6) Ambient temperature extremes (heat/cold stress)</p> <p>7) Site Characterization</p> <p><b>Natural hazards:</b></p> <p>8) Animal and insect bites and encounters</p> <p>9) Inclement weather</p> <p>10) Water/Mud Bog hazards</p>	<p><b>Chemical hazards:</b></p> <p>1) Many of the contaminants as associated with Site 7 have not been thoroughly identified as this site is going through its initial investigation as it pertains to certain media. Safe work practices will be employed as the first line of defense. As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) will be employed as a universal control measure.</p> <p><b>Particulates/Liquids with a Elevated Boiling Temperature</b> -As some of the materials in question are solids (i.e., naphthalenic distillates (PAHs), metals, pesticides/PCBs) and/or bound to particulates, the next control measure to be employed to minimize potential exposure will be good work and personal hygiene practices. These control measures including avoiding hand-to-mouth contact to the extent possible, washing hands and face or using hygienic wipes to remove potential contaminants from hands and face prior to breaks or lunch or other hand to mouth activities will restrict the most predominant route of exposure. Dust suppression methods including area wetting will be employed to control mechanically generated dust emissions.</p> <p><b>Liquids/gases</b> – In situations where contaminants exist in soils or liquid media and present a vapor or gas hazard threat such is the case with Bldg. 105 contaminants, real time monitoring instruments and PPE will be employed to support protective measures. As part of the evaluation method of these subsurface media, all samples will be scanned with a PID to determined potential source concentration.</p> <p>2) <b>Transfer of Contamination into Clean Areas</b> - Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. See decontamination of heavy and sampling equipment for direction in this task.</p> <p>3) <b>Slip, Trip, and Fall Hazards</b> – These hazards shall be minimized by adherence to the practices listed below. This includes</p> <ul style="list-style-type: none"><li>- Maintain proper housekeeping in all work areas.</li><li>- Preview and inspect work areas to identify and eliminate slip, trip, or fall hazards.</li><li>- Cover, guard, barricade, and or place warning postings over/at holes or openings that personnel may fall or step into.</li><li>- For traversing steep, slippery, or sloped terrain establish rope ladders to control ascent and descent to sampling areas or use alternative pathways.</li><li>- Regular Ladders should be placed to allow access and egress from steep embankment and levy walls when collecting samples along Pettibone Creek and the Boat Basin.</li><li>- Use multiple persons and pack small loads to remote locations.</li></ul> <p>4) <b>Strain/Muscle Pulls from Manual Lifting</b> - Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques (See Lifting Mobilization/Demobilization, Page 1 of 6, Table 5-1).</p> <p>5) <b>Cuts and Lacerations</b> – Employ the following measures to reduce and/or eliminate the potential for cuts and lacerations</p> <ul style="list-style-type: none"><li>- Obtain and use the knife and acetate tube retention tub recommended by Geoprobe to prevent potential cuts and lacerations when accessing samples within MacroCore and Dual Tube Sampling System acetate liners. These items have been engineered to allow sample acquisition without putting the sampler at risk.</li><li>- Select and secure the most favorable route to monitoring wells and sampling locations.</li><li>- Previewing pathways - Where possible, remove or demarcate the physical hazards.</li><li>- Inspect all cutting equipment to be used to clear access routes for defects.</li><li>- When cutting items - always use a sharp knife and always cut away from your body. Do not place items to be cut in your opposite hand or on your knee.</li><li>- Carry all glassware and items that present a potential for cuts, lacerations, or impalement such as machetes or brush hooks in protective packaging or sheathed to avoid breakage or exposure in the event of a slip, trip, and/or fall.</li></ul> <p>6) <b>Ambient Temperature Extremes (Heat/Cold Stress)</b> - Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress is provided in Section 4.0 of the Health and Safety Guidance Manual.</p> <p>7) <b>Site Characterization</b> - Work areas will be surveyed prior to committing personnel or resources. The survey will be conducted by the FOL and/or the SSO. The purpose is to identify physical and natural hazards that may impact the proposed work area. These hazards are to be identified, barricaded, or eliminated to the extent possible to minimize potential effect to field crew.</p> <p>8) <b>Animal and Insect Bites and Encounters</b> - To combat the potential impact of natural hazards, the following actions are recommended:</p> <ul style="list-style-type: none"><li>- Avoid nesting – Preview routes, avoid nests, if at all possible.</li><li>- Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control.</li><li>- Tape pant legs to work boots to block direct access.</li><li>- Use repellents – Permethrin should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars.</li><li>- Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin.</li><li>- If working in snake infested areas personnel are directed to adhere to the following provisions:<ol style="list-style-type: none"><li>a. Leave snakes and animals alone, do not harass or try to capture. Contact the SSO for direction in the removal of animals and snakes within the confines of the work site.</li><li>b. Snake chaps or high leather boots should be worn in unimproved or unmaintained areas on an initial sweep of the area, if you are unknowledgeable regarding nesting and habitat considerations for indigenous animals and reptiles.</li><li>c. Keep hands and feet out of areas you cannot see. Exercise extreme care when lifting materials or debris providing ground cover as snakes and other animals prefer these areas to nest.</li><li>d. Be cautious when moving debris or other structures, that may serve as a nest. Do not use your hands to separate debris piles. Use equipment (hand tools or heavy equipment, as available).</li></ol></li><li>- As this activity may take personnel into areas of heavier vegetation, samplers should be cognizant of poison ivy, poison oak, and poison sumac in the area. See Section 6.3.3 for descriptions of these plants. Protective measures to be used to minimize hazards of this nature<ol style="list-style-type: none"><li>a) Avoid direct contact through the use of Tyvek coveralls, clothing, or barrier creams</li><li>b) Wash after contact with cool water and mild soap.</li><li>c) Wash equipment contaminated with the oils of these plants to avoid cross contamination.</li></ol></li></ul> <p>9) Suspend or terminate operations during electrical storms. Return to work when directed by the FOL and/or the SSO.</p> <p>10) <b>Water/Mud Hazards</b> – As part of site preparation, sample locations along Pettibone Creek and the Boat Basin will require marking, mapping, and removal/barricading of physical hazards, as well as, securing access. This will bring persons along the water ways, areas of soft footing and mud. To minimize these obvious hazards</p> <ul style="list-style-type: none"><li>- On a Boat - All personnel shall wear Type III personal flotation devices in the event someone falls overboard, boats sinks or capsizes. Type IIIs were selected as they offer the most flexibility for working while still meeting minimum requirements for bouyancy. In situations where personal flotation devices cannot be worn due to the task to be conducted, Type IV Throwable flotation devices shall be immediately available/accessible.</li><li>- Near Waters Edge -When work activities take personnel within four feet of navigable waters edge and over soft footing (Mud/bog areas) personnel will have immediately accessible a lifeline with a throwing bag or Type IV flotation device facilitate extraction from the water or mud. All personnel working on waters edge and bog areas will do so using the buddy system to assist in rescue efforts, if needed. Where necessary work platforms can be laid down to provide a larger surface area of support in muddy/bog areas.</li></ul>	<p>1) Monitoring shall be conducted to as a general screening effort to qualify and quantify estimated source concentrations of site contaminants in support of the prescribed worker protection levels.</p> <p>Monitoring shall be conducted using a Photoionization Detector (PID) with 10.6eV lamp strength.</p> <p><b>Site 7</b></p> <ul style="list-style-type: none"><li>- 10 ppm in the workers breathing zone for no greater than 10 minutes duration, no more than 4 occurrences in a single day. Action levels of this level will protect personnel from achieving the most conservative TLV/TWA.</li><li>- Dusts/particulates – All dust/particulate concentrations will be maintained to below visual recognition which is estimated at 2 mg/m<sup>3</sup></li></ul> <p><b>Bldg. 105</b></p> <ul style="list-style-type: none"><li>- 10 ppm in the workers breathing zone.</li><li>- Dusts/particulates – All dust/particulate concentrations will be maintained to below visual recognition which is estimated at 2 mg/m<sup>3</sup></li></ul> <p>Concentration in excess of this action level require personnel to stop work, notify PHSO.</p> <p>Monitoring shall be conducted at the prescribed depths as indicated on the boring logs at the source (borehole) and drillers breathing zone. Monitoring shall also be conducted at the samplers location to in the same prescribed frequency when handling samples.</p>	<p>Level D protection will be utilized for the following sampling activities</p> <p>Surface water, groundwater, and sediments</p> <p>Sampler/Oversight Personnel</p> <ul style="list-style-type: none"><li>- Standard field dress (long pants, Sleeved shirts)</li><li>- Steel toe safety shoes or work boots</li><li>- Safety Glasses</li><li>- Nitrile surgeon style inner gloves for sampling</li><li>- <i>Impermeable boot covers</i></li><li>- <i>Reflective vest for traffic areas</i></li><li>- <i>Identified flotation devices</i></li></ul> <p>Protective Measures as specified for drilling and soil boring will be employed for all subsurface soil sampling.</p> <p><b>Upgrades to Level C protection are not anticipated.</b></p> <p><b>Note:</b> The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.</p>	<p><b>Personnel Decontamination</b></p> <p>Sampling surface water, groundwater, and sediments, the following provisions will apply (Remote Locations)</p> <ul style="list-style-type: none"><li>- Upon completion of the sampling dedicated trowels, tubing, etc. will be bagged for transport back to the central decontamination area.</li><li>- PPE (gloves) will be removed and also bagged for disposal.</li><li>- Handi-Wipes or similar product will be used to clean hands, prior to moving to the next location.</li></ul> <p><b>Equipment Decontamination</b></p> <p>All equipment used in remote sampling locations will be brought back to the central decontamination area for decontamination and re-use or disposal.</p> <p>Decontamination of equipment (sampling and hand tools) will proceed as indicated in the Work Plan and/or the QAPP.</p>

## 6.0 HAZARD ASSESSMENT

### 6.1 CHEMICAL HAZARDS

#### Site 22 - Building105 Old Dry Cleaning Facility

Chlorinated Hydrocarbons including

- PCE
- DCE

Analytical data from previous site investigations indicates that contaminant concentrations are not capable of presenting an occupational exposure concern via inhalation. Typical toxicological response associated with inhalation include central nervous system effects of sleepiness, clumsiness, possible headaches, in extreme cases hallucinations, and stupor.

Typical toxicological response associated with contact include irritation at all points of contact if there is sufficient concentrations. Systemically, exposure through these routes may result in nausea, vomiting, weakness, tremors and cramps. Chronic exposures may result in dermatitis, liver and/or kidney damage. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (drilling, soil sampling, etc.). If exposure to these compounds were to occur, it is most likely to occur through ingestion of contaminated soil or water via hand-to-mouth contact. For this reason, PPE and basic hygiene practices (washing face and hands before leaving site) will be extremely important. Inhalation exposure will be avoided by using appropriate PPE and engineering controls where necessary. Significant exposure via inhalation is not anticipated during the planned scope of work.

## **7.0 HAZARD MONITORING**

Site 22 – The contamination at this location includes PCE and DCE as the primary contaminants of concern. Typical responses to these substances is 70% or greater. These substances are readily detected.